THE

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(J. A. BERLY'S).

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ELECTRICAL FINANCE AND INDUSTRY IN 1907.

WITHOUT trespassing on the particular preserves of our special Stock Exchange contributor, we wish to offer a few observations concerning the position of electrical finance during the year just closed, and some of the causes that have worked together to produce the prevailing state of things. Let us take the general classification of the different departments for the purpose of our comments: (*a*) electrical manufacturing; (*b*) electricity supply and power; (*c*) electric tramways and railways; (*d*) telegraph and telephone.

Class (*a*) investor has had very little return upon his capital, save in the case of the cable companies, toward whose profits, we trow, longing eyes have been cast for a number of years. But no one can put his finger upon one characteristic and blame that as the cause of fallen profit; for, as well as what has happened in the way of competition between manufacturers, there have to be borne in mind the effects upon (*a*) of the changes, delays, and want of development, occurring in (*b*) and (*c*). When we attempt to investigate the causes of these, we become involved in a variety of inquiries. Perhaps the more outstanding features of the year have been the falling-off in power-station equipment work and the marked slackening down in tramway and railway electrification. We remember, too, the improved position of the gas-supplier, to be countered by the introduction of high-efficiency metallic filament lamps—when they can be obtained plentifully enough, which they can *not* be now. We are reminded of deferred plant and main contracts, consequent upon the high prices of copper and other materials in the first half-year; of coal prices giving the central-station engineer anxious thought, and reducing shareholders' profits; of socialism and socialistic tendencies; of an awakening against municipal extravagance, with perhaps a temporary lessening of work in consequence, but without a corresponding advance in the work of private companies; of the development in suction gas plants robbing public-supply circuits of good power consumers, and leading to a readjustment of power charges (as at Bradford) in the hope of retaining present customers; of doubt on the part of the London supply companies as to the Government's designs upon their undertakings, putting a brake upon progressive extension policies. We remember, too, how tramway troubles have been rife, such as track depreciation and renewal, rail corrugations, brake problems, the effect of the phantom of petrol motor-omnibus competition—now almost dispelled; of abandoned tram routes where new lines would have been laid had there been national prosperity requiring new building operations, creating traffic where there was none before. Then, again, 1907 has heard the tramway director grumbling, in true annual-meeting fashion, about the oppression under which

tramway companies labour in having to charge low fares. Municipal authorities in big towns may charge low fares and make profits, and this sort of thing has, in a way, indirectly fixed the fares chargeable under concessions in smaller and quite dissimilar places. If tramways are to be reasonably remunerative to the investor, perhaps, in some districts, the passenger will have to be prepared to pay more. Tube railways have been feeling their way toward more equitable fares in view of competition of other modernised transportation facilities. We think, further, of railway electrification discussions, long-awaited experimental lines, and the difficulty of railway companies raising money even if they were sure which system to adopt. And many other causes or effects, or both, leading to the investors' indisposition to speculate, and to reduced work for the manufacturer from the lighting and traction departments, and a low rate of profit on that lessened output, may occur to the reader.

But there is one matter that must not be omitted—it is the effect of over-confident estimates formed years ago by promoters of large manufacturing and supply organisations, estimates sometimes reckless, sometimes excusable because men cannot see far ahead as to probable electrical development. The reduction and re-arrangement of capital which had to be undertaken by the Westinghouse Co. early in the year is now followed, as we leave the year behind, with a wrestling between the board and debenture-holders consequent upon the results of the American panic. The Brush Co. has carried through another reduction of capital. The British Thomson-Houston has not yet been financially recompensed for taking up its abode in this country. Edmundson's and British Electric Tractions have been going the pace downhill. The South Wales Power Distribution Co. is splitting itself up into small fractions for operation as isolated local systems. *R.I.P.* All of these and some other things like them weaken confidence in electrical undertakings and make the investor disinclined to speculate where there has been so much of misfortune and where there is still weakness and uncertainty.

Of course, good trade may absorb capital and make a scarcity of money for general investment and thus depress securities owing to the lack of demand, but a series of unfortunate events in electrical finance and some untoward circumstances in practical electrical performance have inevitably added their own evil influence. The falling off in some trades, which prophets of evil are foretelling, may not require much new capital to be put into these trades for a time, and there may be more money available to buy electrical securities and prices may improve with the demand, but blemishes are always regrettable misfortunes. Some of them will yet have to be removed before the complexion of electrical finance will be altogether unmarred. And they cannot be removed or effectively smothered up by crying out for a new toy in the form of a mutual improvement society, by blaming legislation, by saying that foreign competition is at the bottom of it all. Many are the causes of what we have recited above, and they are not all the result of conditions—sometimes men and their methods have been to blame.

The telegraph and telephone departments are perhaps the cleanest and most satisfactory that we have any concern with. There are few stronger lines than our telegraph securities, yet these have been very sensitively susceptible to the passing mosquito sting or pin-prick of "Commercial" wireless telegraphy across the Atlantic. It is remarkable that what has been achieved should have excited even so many women in the country that they have sold out good stuff so readily. British telephone securities in all parts of the world have had a most satisfactory experience, whether we think of Nationals, of South American, of Anglo-Portuguese, or of Orientals.

Specification Abuses.

Some years ago we carried on a weekly criticism of specifications for electrical contracts, and from time to time we have returned to the subject to draw attention to the abuses of privilege and the unfair stipulations which are continually cropping up, and which it is curious to note are invariably directed against the long-suffering contractor—who is not really such an irredeemable scamp as some consulting engineers seem to think him.

Recently a case was brought to our notice in which plans and specifications were to be had only on deposit of "one pound sterling (*not returnable*) to cover cost of preparing same." The sting lies in the words which we have italicised. It is to us a novel suggestion that the unsuccessful contractors shall be called upon to pay a large share of the office expenses of the consulting engineers (or architects? we cannot find the name of the firm in any directory at hand); surely they have enough expense to bear already, in the preparation of their estimates, and often travelling expenses also, without contributing to the support of the consultants. Moreover, there is no limit to the number of copies that may be sold in this way, or to the corresponding profit to be made by the consultant. The practice may be suitably characterised as blood-sucking, and we trust that electrical contractors will have nothing to do with the leeches who thus seek to augment their gains at the cost of the losers. We trust they are architects.

Another blatant example lies before us. It is the general specification and terms of contract for the electric light installation in a London block of flats, supplied from the Marylebone mains. One of the clauses provides that a penalty of £3 per day shall be paid as liquidated damages "for every day the work remains unfinished to the satisfaction of the authorities and architects" after the specified date for completion. There are great possibilities in a clause of this kind. There is no reservation relieving the contractor in case the delay is due to action or inaction on the part of the architects or the owner, and obviously it would be in the interests of the latter to cause delay, provided that he incurred no loss on other grounds. In the present instance, part of the flats might be left incomplete until the others were let, and the job might not be finished till the Greek calends.

As regards payment, 75 per cent. of the contract sum is to be paid "as the work proceeds, 10 per cent. on completion, the remaining 15 per cent. on completion of guarantee"; the guarantee period, we find, is no less than *three years!* This means that the contractor has to stand out of his profit—perhaps, in these days of keen competition, out of part of his capital as well—for that period. There is no apparent reason why the ordinary twelve months' guarantee should be exceeded—that is amply long enough, if anything too long. But *three* years! Truly, this gives point to the "Pertinent Questions" recently put to contractors in our "Correspondence" columns—are they in business for recreation?

The architects are provided with power to employ other contractors to complete the work if the contractor does not get along quickly enough; apparently the latter need not receive notice of the proceeding, but he must pay the cost and continue liable for the penalty. The architects can also suspend the work at pleasure, for an indefinite period; such period is to be added to the period set for completion, and the work might hang on for ever. Moreover, the three years' guarantee *commences* from the completion of the contract.

The contractor usually insures his own plant; but in this case he is held "responsible for injury from fire that may be attributed to his work." Apparently he must insure the whole building for an indefinite period—but, obviously, at least three years in addition to the duration of the work of installation.

Lastly, "This agreement shall hold good for *seven years*." Does not this extraordinary clause throw some light on the foregoing, and bear out our suggestion that the contractor is to be kept hanging on the job for years and years? How any contractor with his eyes open could walk into such a

trap passes our comprehension. The specification is one of the worst productions that we have seen, or, we hope, shall ever see.

Training of Apprentices.

SOME four years ago, namely, in the month of December, 1903, a committee of the North-East Coast Institution of Engineers and Shipbuilders made certain recommendations with a view to stimulating apprentices to take up evening courses of study and to sit for the recognised examinations, say those of the Board of Education, the City and Guilds Institute, and those of the Armstrong College, Newcastle.* It was recommended that firms employing apprentices should adopt a system of marking for recording the time-keeping, industry and evening study of the engineering apprentices, and whilst a general scheme was outlined, each firm was at liberty to make such amendments as the special conditions obtaining in the several works necessitated.

A short paper has recently been read before the above-named Institution by Mr. W. G. Spence, Vice-President, who is connected with the Neptune Engine Works, that is to say, the Engine Works of Messrs. Swan & Hunter and Wigham Richardson, Ltd., one of the largest and most important engineering works on Tyneside.

The general outline of the scheme was given in the ELECTRICAL REVIEW, March 18th, 1904, p. 446, and the Neptune Works, whose proposals we referred to in our issue of February 20th, 1904, p. 325, have now somewhat modified it, their general scheme being as follows :—

At the end of September in each year each apprentice is awarded marks as below :—

For each approved examination in science or in mathematics (not exceeding three in number) passed during the year, marks are awarded according to a schedule, which takes into consideration the nature of the examination, and the class or grade passed.

For time-keeping : a maximum of 120.

For good conduct, industry, and progress in the workshops : a maximum of 120.

Marks for time-keeping are deducted at the rate of one mark for every hour lost, but no deduction is made for special leave, or for sickness if certified by a doctor.

Conduct marks are awarded quarterly on the following scale : Very good, 120 marks ; Good, 90 marks ; Fair, 60 marks ; Moderate, 30 marks.

An apprentice obtaining 180 marks in the aggregate has the sum of sixpence added to his weekly rate of pay for the ensuing year ; for marks in excess of 180 his rate is proportionately increased.

No payment under this scheme is made to apprentices obtaining less than 180 marks, and apprentices who fail to obtain a reasonable number of marks for time-keeping, good conduct, industry and progress are subject to dismissal.

Apprentices commencing their apprenticeship between October 1st and March 31st are entitled to half-rates for their first year.

Marks are only given for examinations passed in the year for which the certificate is issued, except in the case of those students who sit for the "Honours" examination, having already passed the advanced stage in some previous year. Such students, in case of failure to pass the "Honours" examination, will be allowed to count the marks they earned previously at the advanced examination. This is done with a view to encourage apprentices to take the higher courses of study.

Students are expected to show improvement each year in the results of their examinations, and the full marks allowed for any given pass can only be obtained in one year. Should the student only succeed in obtaining the same pass a second time, the marks obtainable are reduced by 10 per cent.

The author gives several curves based on results obtained during 1907 : curve A showing the number of marks gained and the time lost by each individual student ; curve B the marks gained for conduct and industry ; curve C the number of marks gained for evening study ; the whole of the results of the foregoing curves being combined in curve D, whilst curve D_1 shows a comparison of the results obtained during the four years 1904 to 1907 inclusive. Other curves are given showing the average marks gained in the various sections. The author is of opinion that the curves show a very creditable "bucking-up" among the youths ; but the human tendency to backslide is evidenced, the year 1905 appearing to show the best results, and 1906 and 1907 both falling short of this.

Another impression gathered by the author is that the number of apprentices who do efficient evening-class work is a very small percentage of the total, only one out of every five showing any results at all, and that the work done is of a very rudimentary character. On this account Mr. Spence suggests that it is better for technical colleges to aim at giving assistance which will enable a few to raise themselves above the average, and so to pass on to further advancement, rather than to attempt to produce a light crop over a large area. In other words, instead of trying to raise the general standard, it is the author's opinion that it is better to devote more attention to the developing of those showing more than average ability. Touching on this question, he remarks that whilst it is a waste of labour to attempt to polish lead, the small amount of silver in it, if extracted, can be given a high polish with advantage. A further important point which the author brings out is that only exceptionally strong youths, that is, strong both mentally and physically, can make any great headway by evening study if they are fully occupied during the day-time in engineering works. For this reason the Neptune Works allow the head apprentice each year to commence work in the following year at 9 a.m. instead of 6 a.m., full pay being credited during this period. The records of these results are most interesting from the point of view of the education of apprentices, and the Neptune Works have performed a very useful service to the engineering industry in keeping accurate records of the working of the system and in publishing them in such complete form.

* See ELECTRICAL REVIEW, February 20th, 1904, p. 325 ; March 18th, 1904, p. 446 ; October 16th, 1904, p. 611.

Municipal Extravagance.

THE Bridlington T.C. recently made application to the L.G.B. for sanction to borrow £11,500 for the extension of the waterworks, on the advice of Mr. Bancroft, waterworks engineer of the City of Hull. This is a striking example of municipal mismanagement. It was urged by the Ratepayers' Association that the power for pumping should be supplied from the Council's electricity works. The work could have been done most economically, and would have provided a valuable day load for the station. Nevertheless, the Council is about to spend a large sum in order to provide steam power plant in duplicate, for a total requirement of less than 70 H.P.

A couple of motors of 50 KW. each, with pumps and switchgear, could have been installed for less than a tenth of the sum proposed, in a far smaller building ; and the running costs would have been reduced, as regards energy, attendance, repairs and stores, quite apart from the benefit to the electricity department. When municipal officials and authorities embark on municipal trading, why cannot they realise and take full advantage of the principle of centralisation, which is so peculiarly applicable to such undertakings ?

Their object often seems to be to find the most expensive way of doing a thing, and then to adopt that way. It is not suggested that the whole of the sum above-named will be laid out on the steam plant and buildings ; but a very large proportion of it is due to the use of steam instead of electric power.

DIRECT-READING GALVANOMETER SCALES.

By J. RYMER-JONES.

The following method saves much time and calculation when the dielectric resistances of a number of condensers, or insulated wires, have to be measured.

Of the two parallel-scales shown in the figure, the lower one is divided into 1,000 equal divisions, while the upper D R scale is so graduated that its insulation values are in inverse proportion to the divisions on the lower scale.

If, therefore, the testing galvanometer be shunted to make the testing battery through one megohm give the full deflection of 1,000 divisions, and if this deflection is, moreover, made to coincide with the one-megohm graduation on the upper scale, then deflections of 500, 250 and 125 divisions should coincide respectively with 2, 4 and 8 megohms; and there should be a similar coincidence between all intermediate deflections and their corresponding D R values.

The disk of light, with its fine dark line as an index, is reflected from the mirror galvanometer between these two scales, either of which may therefore be equally well used as desired.

As the universal shunt is not always sufficiently subdivided to give exactly the full scale deflection of 1,000 divisions with the testing battery through one megohm, the multiplying power ($m\,p$) of the slide reading ($s\,r$) required to give 1,000 divisions is obtained by inverse proportion from the deflection (d) observed with a suitable slide reading having a multiplying power M P; *i.e.*, $m\,p = \text{M P}\,\frac{d}{1{,}000}$, and its $s\,r = \frac{10{,}000{,}000}{\text{M P} \times d}$. Or if, when employing a universal shunt of 10,000 sub-divisions, a slide reading of 10, having a M P of 1,000, be used, we simplify the formula by making $m\,p = d$, for which the $s\,r = \frac{10{,}000}{d}$.

Although the insulation values of a set of condensers, or insulated wires, made under the same conditions generally agree closely, and can therefore be tested with the same scale, the D R of other sets will differ greatly according to capacity, specific resistance, or temperature; consequently several galvanometer scales with widely different D R ranges are required. The principle of graduating the upper scale is, however, the same; but instead of the lowest insulation value (R l), which always coincides with the 1,000 divisions, being only one megohm, as assumed above for the purpose of explanation, it will be according to the requirements, and the slide reading ($s\,r$) used for each scale must be in direct proportion to R l.

For example: If it be required that the lowest D R value (R l) in the upper scale, coinciding with 1,000 divisions on the lower scale, be 200^{Ω}, the slide reading ($s\,r$) to suit this particular scale will be—

$$^{*}s\,r = \frac{10{,}000 \times \text{R}\,l}{d} = \frac{10{,}000 \times 200^{\Omega}}{d} = \frac{2{,}000{,}000}{d},$$

and deflections of 500, 250 and 125 should coincide respectively with 400, 800 and 1,600 megohms.

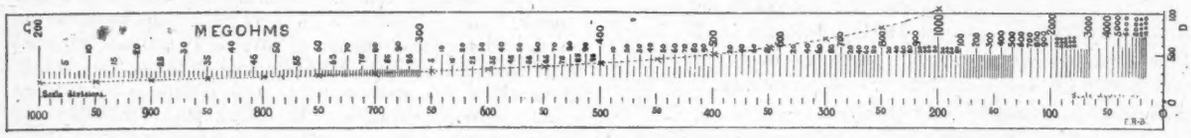
By thus using a D R scale, and its particular shunt value, to suit the insulation of a set of condensers, or insulated wires, the readings are kept well up the scale, and undesirably small deflections avoided.

If, when using a scale with its proper $s\,r$ value, the insulation deflection (δ) is greater than 1,000 divisions—*i.e.*, the D R to be measured is less than R l of that scale—halve $s\,r$, and the D R reading divided by 2 gives the correct result. Similarly, when the calculated $s\,r$ is above the 10,000 available in the universal shunt, set the slide contacts to half the value and divide the D R indicated on the scale by 2.

To avoid reading low down the scale, where the D R graduations become small, it is convenient to have (say) five different scales with the following D R limits. By testing one of the set with Scale 1, it will immediately be seen whether this, or which of the D R scales, is best suited for the condensers, or wires, to be tested.

Scale No.	D R limits — R l	10,000 × R l	$^{\dagger}s\,r = \frac{10{,}000 \times \text{R}\,l}{\text{M P} \times d}$ $^{*}s\,r = \frac{10{,}000 \times \text{R}\,l}{d}$	Divide D R reading by
1	200^{Ω} — $1{,}600^{\Omega}$	2,000,000	2,222	—
2	400 — 3,200	4,000,000	4,444	—
3	800 — 6,400	8,000,000	8,889	—
4	1,000 — 8,000	10,000,000	5,555	2
5	2,000 — 16,000	20,000,000	7,407	3

As the value 10,000 × R l for each of the above scales does not change, and the only varying quantity is the deflection d (depending on the constancy of the battery and galvanometer), all that has to be done before testing a number of condensers or insulated wires, is to observe the galvanometer constant with the full battery through one megohm ‡, employing for the shunt, when practicable, a slide reading of 10, and to divide the deflection (d) into 10,000 × R l in order to obtain from the formula the $s\,r$ to be used with that particular scale.



Direct-Reading Galvanometer Scales.

Temperature Coefficient.—If instead of reading the D R at the actual temperature (say 70° F.), it be desired to read it at a standard temperature (say 60° F.), the coefficient (r) for the 10° difference in temperature (as given in a coefficient table) is included in the formula, which becomes—

$$^{*}s\,r = \frac{10{,}000 \times \text{R}\,l}{d \times r}, \text{ or } ^{\dagger}s\,r = \frac{10{,}000{,}000 \times \text{R}\,l}{\text{M P} \times d \times r}.$$

If, in error, a wrong $s\,r$ has been employed, find from $\text{R}\,l = \frac{s\,r \times d}{10{,}000}$ (or from $\text{R}\,l = \frac{s\,r \times d \times r}{10{,}000}$ if the temperature coefficient is included) what resistance (R l) is equivalent to 1,000 deflections for the $s\,r$ used, and correct the results observed by the difference per cent. between R l of the scale, and the calculated R l for the shunt used.

Graduating the D R *Scale.*—The D R values (R) equivalent to (say) every 50 divisions, are obtained for any scale by multiplying its R l × 1,000 by the reciprocal deflection (δ). Then by plotting their values on a curve sheet, where the galvanometer deflections represent abscissæ, and equal insulation values—suitable to the D R limits desired—are scaled as ordinates, we obtain a curve to facilitate graduating.

When the D R limits of a scale are considerable and the megohms represented by each small sub-division of the ordinate scale consequently large, it will be more exact to calculate from the following formula the deflection δ, which coincides with every 10 or 20 megohms, and to mark the D R scale accordingly—

$$\text{R} = \frac{\text{R}\,l \times 1{,}000}{\delta}, \text{ and therefore } \delta = \frac{\text{R}\,l \times 1{,}000 \text{ divisions}}{\text{R}}.$$

* It is here assumed that the constant deflection (d) = 900 divs., with shunt reading 10, *i.e.*, M P = 1,000.

* When the shunt reading = 10, *i.e.*, M P = 1,000.

† When the shunt reading and its multiplying power has another value.

‡ Or one-tenth of testing battery through $100{,}000^{\Omega}$ when one megohm is not available.

Instead of using an upper specially calibrated D R scale, the insulation deflection (δ) may be read from a scale of 1,000 equal divisions, and the equivalent D R obtained at once by referring to a table in which D R values for any deflection (δ) are given in parallel columns, corresponding to the same D R limits as for the alternative D R scale method, and with the particular shunts, calculated from either of the above formulæ as required. The table is constructed as follows :—

Deflection.	$\frac{1,000}{\delta}$	R l 200—1,600	R l 400—3,200	R l 500—6,400	R l 1,000—8,000	R l 2,000—16,000
(δ)	(ρ)	R $l \times \rho$				
1,000	1·000	200·0	400·0	500·0	1,000·0	2,000·0
998	1·002	200·4	400·8	501·0	1,002·0	2,004·0
996	1·004	200·8	401·6	502·0	1,004·0	2,008·0
994	1·006	201·2	402·4	503·0	1,006·0	2,012·0

GREAT INTERNATIONAL EXHIBITIONS.

(*Concluded from page* 38.)

1906, Milan, £5,300.—Under a Committee of the London Chamber of Commerce, with Lord Brassey as Hon. President, Sir Albert Rollit as President, Mr. Arthur Serena as Hon. Executive Commissioner and, as joint secretaries, the secretaries of the London Chamber of Commerce, the Associated Chambers of Commerce, and the Italian Chamber of Commerce in London. The Government made a grant, under great pressure, of £10,000, £3,879 was received from other sources and £4,700 was returned to the Treasury. There being no guarantee fund, the executive worked in constant fear of spending too much money. The grants by other Governments were as follows, viz. :—Austria-Hungary, £8,333 ; Germany, £18,500 ; Switzerland, £24,060 ; France, £11,119. We have already commented on the results of this exhibition.* Moreover, it was not universal, as the exhibits were confined to certain classes.

1906-7, Christchurch, New Zealand, £8,000.—Under a committee of the Colonial Office and the Board of Trade, which prepared a Government exhibit with the help of Col. Sir Charles Watson, Captain Percy H. Atkin being the British Commissioner. The trade exhibits from this country were small and unrepresentative, but well arranged and attractive ; they were obtained by the High Commissioner. The Art Section was particularly successful, as were some of the exhibits from other Colonies. In these notes no allusion has been made to the Art Sections, nor to the Colonial exhibits, thereby following the example of the French Government in 1900, which refused to recognise them as distinct from the Mother Country ; this is natural enough, for it appears to be only just dawning on the authorities that the British Empire consists of many nations, who, although all remaining under one flag, will soon insist upon being treated as the equals of other Powers.

The general effect of exhibitions on British arts, industries and trades, may well be inferred from the want of some continued policy which, so far, has characterised our participation in International Exhibitions ; in fact, the results generally have not been commensurate with the expense, the loss of valuable time, and the worry that have been entailed. It is, of course, difficult to estimate the direct profits, and still more so the indirect profits resulting from great international exhibitions, but it may safely be asserted that many of our traders and manufacturers, and consequently the nation, as a whole, has lost both business, profits and prestige by our non-participation in an adequate manner in these World's Fairs. It would be presumptuous to try and teach their business to our great merchant princes and the less exalted members of that commercial world which has placed Great Britain in her present proud position ; it may, however, be permissible to point out that our foreign rivals, who are not altogether devoid of intellect and commercial aptitude, have found it pay, both as individuals and as nations, to continue spending enormous sums on these occasions, and to form associations for joint action, whereby this large expenditure has been laid out to the best advantage.

Even in our case it has been shown that collective exhibits, whether by private individuals or by Government Departments, have been more successful as a general rule than those of individual firms. These exhibitions may be termed advertisements by samples ; where the samples are few in number, badly displayed, and not of exceptional merit, they do not redound to the credit of either the exhibitors themselves or of the nations to which they belong. It is to these defects and not altogether to the demerits of great exhibitions, that the comparatively poor results of the more recent events are due, *i.e.*, from a purely trading point of view.

The question of awards is one of which it might almost be asserted *quot homines tot sententiæ*. That, if anything, they have been given too lavishly, and that in many cases they have been awarded for reasons other than those of individual merit, cannot be denied—but that in many cases they are greatly sought after and valued when obtained is also incontestable. On the whole, it may said that they are an advantage to their possessors, and that they have been fairly distributed. One curious fact about them is to be noted ; any member of a jury is not entitled to an award, and is classed as "Hors concours." It has often been supposed that this meant that the exhibitor had already been awarded the highest honour on some previous occasion, and, consequently, positions on juries have been eagerly sought in order to convey that erroneous impression. That the present state of affairs is highly unsatisfactory has been recognised by all those who have been responsible for the quality and quantity of our representatives. The Departmental Committee of the Board of Trade on the subject arrived at the same conclusion, and they have formulated a scheme which they hope will remedy these defects from an official point of view. This we will now proceed to discuss, with reference to our future course of action.

The British Empire at all great international exhibitions should be represented on a "two power" scale. Presuming that those held in national capitals, or in principal industrial centres, under the auspices of the foreign Government, would not take place at less intervals than five years, and that our Imperial grant would be no less than £200,000, this would represent an annual charge of no more than £40,000 from the Mother Country, and its Colonies and Dependencies. Seeing that many single firms spend many thousand pounds a year on advertisements, this charge sinks into significance if thereby the arts and industries of our 400,000,000 subjects are adequately displayed. Presuming also that it is a waste of time to go into details which would be settled from time to time by the organisation we will proceed to adumbrate, it will be sufficient to mention in very general terms the lines on which we suggest it should be formed.

The work of an exhibition can be divided into two heads, viz., that done abroad, and what has to be effected at home. The first should be under the Foreign Office, the new Imperial Secretariat, and the India Office ; the second should be under the various Home Governments, working in touch with commercial and trades' organisations. These duties should be carried on harmoniously by all concerned, that is, they cannot be divided into water-tight compartments, having no intercommunication with each other. The duty of the three first offices should consist in carrying out in collaboration with their local representatives, all the *pourparlers* in the country holding the exhibition. They should arrange for buildings and spaces and the allocation thereof ; they should open labour bureaux for obtaining the workmen required on the spot, and should facilitate the transport and Custom formalities by obtaining concessions from foreign railways, by arranging for the carriage of goods on to or off the ground, and for the storage and deliveries of empties ; the incidence of such charges to be arranged by mutual arrangement (according to circumstances) with the other branches of this organisation.

The Home Governments should be responsible for their own collective exhibits, for the carriage of all goods from their place of origin to the foreign port, and they should obtain concessions from their own carriers and railways for the charges on such goods, and should be in constant and intimate touch with all the trades and commercial organisa-

* January 11th, 1907, page 77.

tions. The India Office and the Agents-General would form part of their branch. This branch would make every possible use of the commercial intelligence of the Board of Trade and of the Chambers of Commerce of their respective countries, and of any special exhibition or office that might be established from time to time—such as the South African Organisation, the Indian and Colonial Clubs, the Franco-British Exhibition, and the offices it is now proposed to locate in Crosby Hall. There should be a small permanent office, with a first-class man at its head to ensure a continued policy of these two branches.

Last, but not least, come the private exhibitors. This very independent body must be left to work out its own salvation—it cannot be coerced—it is not easily cajoled, and owing to its jealousy of official interference and, in many cases, of its individual members, no rules and regulations will apply unless evolved from within. Now possible exhibitors can roughly be divided into four classes—viz. :—(1) Those who exhibit *quand même* at almost every opportunity ; (2) Those who would like to exhibit if they could be relieved to a sensible extent of trouble and worry ; (3) Those who would exhibit but cannot afford to bear all the expense ; and (4) Those who will not exhibit at all under any circumstances. Now, with all diffidence we venture to suggest that the first class might form themselves into an association similar to the *Comité Français des Expositions à l'Etranger*, which at present consists of over 2,000 members, composed mainly of representatives of firms who have won high honours at exhibitions ; these pay an entrance fee of 20 fr. and an annual subscription of 30 fr.; equivalent, it may be considered, to 2,000 gs. down and 3,000 gs. per annum respectively. It can safely be asserted that our merchants and traders would be prepared to subscribe very much more towards an organistion formed by themselves and in which they had confidence. To this body would be entrusted all the arrangements whether for individual or for collective exhibits. Working in conjunction with the other two branches, we have no doubt that this association once started would soon absorb two of the other three classes, and might, in time, overcome the objections of the fourth class, if, by such means as we have ventured to sketch out, the paths of exhibitors were made pleasant and easy instead of being beset by difficulties of all kinds causing that expense and worry which deters so many from any participation in international exhibitions.

The Grand Exhibition of Japan, which will take place at Tokio from April 1st to October, 1912, will give this Empire a splendid opportunity for showing what she can do, if, by taking warning from the past, she sets about the work of preparation in good time and under some system by which a fair idea will be given to our good allies, the Japanese and to the world in general, of the vastness of our resources. The spirit in which this undertaking should be approached is well expressed in the eloquent words of Mr. Géo. Gérald, the Deputy Commissioner-General of the French Government at the St. Louis Exhibition—words which, however, we fear, will lose a great deal in the translation. They were addressed to a meeting of the Council of the Société Française des Expositions à l'Etranger, in 1905 : "There is nothing more worthy of praise, more obligatory than the emulation you encourage every day by going forth and showing yourselves in other countries. Exhibitions are often ill-spoken of ; the speakers mistake both the hour and the season. Exhibitions have been and are now the battle-fields of nations, where absentees are always vanquished. Ah, times have changed ! We fight now not for territories, but for customers. The old-time worries of statesmen are making way more and more for the burning and more vital questions of the industrial and commercial development of nations. Policy is entirely dominated by the overwhelming importance of these interests and of the many points of view from which they may be studied. These are the interests which now bring nations together or force them apart. Commerce is their salvation and will shape their future. Woe to those who neglect this through laziness, through a fatal indifference, or through a culpable inattention ! The day before yesterday at Brussels, at St. Petersburg, at Glasgow, at Hanoi ; yesterday at St. Louis ; to-morrow at Liége, at Milan, at other places, indeed, wherever an effort had to be made, an interest had to be protected, an industry had to be defended, a victory had to be gained, you have been to the front and need no reminding, though it cannot be too often repeated, that in these times the commercial man has to be, more than ever before, a daring conqueror, as enterprising and as resourceful as he is untiring. It is to those who are not with us that all this has to be said and repeated over and over again, while showing them figures and facts, and putting their fingers on the disastrous consequences of not applying remedies in time. It will require the efforts of all those who realise the world's economic evolution to awaken our energies, to modify our tastes and our habits, and to adapt them to the wants of the hour."

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Series Arc Lamps.

In reply to "Linkman," I venture to suggest a rough and ready, though easy, method of localising the faulty lamp in a series, if it is due to a burnt-out or disconnected shunt coil. If the carbons of one lamp of the series be separated, the current flowing through the shunt coil of that lamp (if in order) will produce a visible spark on opening the switch. Repeat the process on each lamp till no spark appears on breaking circuit.

F. C. Grimwood.

London, W., *January 5th*, 1908.

In reply to "Linkman," he can easily test for the faulty lamp by shorting each lamp in turn ; when the bad one is cut out the remainder will burn normally. Of course, this method is only applicable when the total number of lamps is such that on one being shorted the remainder can safely stand the increased voltage. I have used this method with success with five lamps in series on 500 volts. As the set should be adjusted to each other, I generally leave the bad one shorted until the following day, when the lamps are not required, and then readjust the set.

S. K. Broadfoot.

Hollinwood, *January 5th*, 1908.

The value of the "Correspondence" columns of your very instructive journal cannot be too fully appreciated by any of your readers. The contributions published therein—from the pens of able men—are of inestimable value in the service of the engineer ; but when we read such articles as "Linkman's"—published in the current issue—one cannot but feel indignant at the mis-use of the space so courteously placed at your readers' disposal. The question would be a reasonable one—if unaccompanied by such a shallow display of self-importance. In asking for a method of detecting a faulty arc lamp in series with others, he states :—"from time, and other considerations," he cannot apply, presumably, such tests as are within the knowledge of any competent arc lamp trimmer.

He further states :—"I may mention that I am a practical electrician accustomed to testing instruments and the general mechanism of arc lamps !" Why the query ?

I can only say that if those arc lamps are still "jumping" —waiting for somebody's wrinkle—then there is some doubt as to the veracity of the statement he makes concerning his own proficiency.

Carbon.

Private Supply of Electricity.

In a small town in the Midlands there is a block of buildings (shops, &c.), the occupiers of which are not satisfied with the gas, which is of a very inferior quality, supplied by

the Local Gas Co., and they are thinking of forming a small syndicate to put down a private plant and supply themselves with current. The supply cables could be run on the inside of the block, and therefore would not cross any public place or roadway whatever. Would this be legal, provided that the necessary permissions were granted by the several owners of the property?

X. Y. Z.

[This matter has been repeatedly dealt with in our "Legal Query Column" (see especially ELECTRICAL REVIEW, January 4th, 1907, page 42; and January 11th, page 47). Our correspondent and his friends are perfectly at liberty to supply themselves with electricity, without interference from the local or any other authorities whatever. They may also carry their cables across public roads and supply the whole town with electricity if they choose, provided that in this case they comply with the Board of Trade regulations and, of course, obtain the necessary wayleaves.—EDS. E.R.]

A Question of Policy.

A propos of your letter from "Y. X. Z." last week, which was very much to the point, I received this morning a letter extolling the virtues of, and a pamphlet illustrating, an electric fire preventer. On the left-hand side of the pamphlet there is a beautifully ideal picture of about 12 in. of flame playing round a piece of flexible cord. Do the gas people and others cry "stinking fish?" Why should electrical people, after for two decades or more preaching the safety of electric lighting, send out circulars talking about means of preventing "electric fires"?

Provincial.

Westinghouse-Bremer Patents.

In further reference to our previous communication, and in reply to the British Westinghouse Electric Manufacturing Co.'s letter of December 28th last, we desire to point out that notice of appeal has been given from the Comptroller-General of Patents' decision, and until this matter has been finally decided on appeal, no final decision has been given.

The proceedings taken against us are premature, and are being opposed, and the object of the communication to you is, therefore, wholly misconceived.

For **D. Santoni & Co. (1906), Ltd.,**
LOUIS DE NEVERS, *Secretary.*

London, E.C., *January 6th*, 1908.

[See our "Notes" to-day.—EDS. E.R.]

Production of Energy from Peat.

Mr. Tomlinson is not far out in assuming that I saw the impracticability of his scheme in 15 minutes; but it took considerably longer to study Dr. Caro's precisely-worded report on the peat trials at Messrs. Brunner, Mond & Co.'s works; and by converting the metric figures which Dr. Caro uses, to verify that Mr. Tomlinson and Mr. Lennox and Mr. Sturgeon had all confused figures which Dr. Caro states to refer to "peat calculated free from water," viz., non-existent chemically dry peat, with the peat with 45 per cent. moisture as delivered to the producer.

In the 15 years during which I have been engaged in the manufacture and sale of drying plant, using both direct and waste heat, and in the manufacture and sale of stokers for the economical combustion of fuels, I have been inundated with peat-fuel schemes; and I have also had occasion to visit Continental, Colonial and American peat-fuel plants; while I also have particulars of the American peat dredging and drying scheme on which Mr. Lennox's scheme is based.

This Irish scheme, as Mr. Tomlinson showed, is based on getting "fuel for nothing," viz., on converting peat into a condition suitable for a gas producer at less than 3s. per ton, and in recovering 3s. per ton from the by-products. Mr. Tomlinson admits that this cannot be done with air-drying, and his scheme rests on the proposal to dry the peat down from 70 to 45 per cent. moisture, by the waste heat in the cooling water and in the exhaust gases of a producer-gas engine; viz., such waste heat must be sufficient to evaporate 1½ lb. moisture, for each lb. of chemically dry peat = 1·8 lb. peat actually delivered to producer with 45 per cent. moisture.

Mr. Tomlinson shows that a Canadian peat dryer, on a test, showed 45 per cent. heat efficiency; but this dryer evidently had direct combustion of fuel, which would give high temperatures, and, therefore, rapid drying in small space.

Mr. Tomlinson shows that if half the total heat of the fuel is available for drying in the form of warm jacket water and exhaust gases, then 4,322 B.TH.U. will be available to evaporate 1½ lb. moisture, theoretically requiring 1,650 B.TH.U., which is 36 per cent. efficiency.

But, as Mr. Sturgeon shows, the gas produced by 1 lb. of 8,644 B.TH.U. chemically dry peat is only 5,825 B.TH.U., so the heat loss in the producer is 33 per cent.; and if the gas engine had the proposed thermal efficiency of 30 per cent., it is clear that only 37 per cent. = 3,198 B.TH.U. could remain in the warm jacket water and exhaust gases, when the dryer would have to have 51 per cent. efficiency.

If cost and space, and time in process, were no object, it might be possible to get a high efficiency in a low-temperature dryer; but Mr. Lennox's "auto-dryer," as proposed, is a vertical steel dryer which could only leave the peat a short time in process; and anyone with practical experience of drying plants will agree with my estimate that only about one-tenth the drying effect could then be looked for, as compared with a high-temperature direct-heat dryer as used in the Toronto test.

All peat schemes involving artificial drying, and/or considerable capital charges, have always failed, for these reasons.

But, even assuming that such a plant could get "fuel for nothing," the prospect would not be encouraging.

The present scheme is to generate electricity at the bog, and to transmit it 25 miles into Dublin.

The Dublin electricity works, out of a total cost of 1·52d. per KW., spends 0·55d. per KW. for fuel; at 14s. per ton, this is over 7 lb. coal per KW., and there is no reason why this should not be much reduced, say to 4 lb. coal per KW., or 0·30d.

Mr. Tomlinson expects to get 10,000 B.H.P.-hours from 100 tons of wet peat, which is about 300 KW. hourly, and would involve a producer gas plant of, say, 2,000-KW. capacity; seeing that the Dublin steam plant is 4,500 KW. capacity, with a load factor of 13 per cent., viz., under 600 KW. hourly average supply of lighting and power.

It would be fair, then, to assume the capital cost of the producer gas plant with by-product recovery and generators, &c., at, say, £40,000; and Mr. Lennox's plant for dredging and converting 100 tons wet peat daily is a further £5,000, exclusive of buildings; the 25-mile transmission would involve further heavy capital charges. It would be much better to pay even 0·55d. for fuel in Dublin than to get fuel for nothing at the bog, and to have such enormous charges on so small a peat gas and transmission plant.

One final point deserves notice; Mr. Lennox shows that 100 tons of wet peat should be dredged, converted, dried and delivered to the gas producer for £5 19s. 2d. (assuming that the waste heat could do the drying down from 70 per cent. to 45 per cent., which we have seen to be impossible). By an odd error, Mr. Lennox and Mr. Tomlinson take the product of 100 tons wet peat with 90 per cent. moisture, to be 50 tons of peat with 45 per cent. moisture, and on this error the figure of 2·4s. = under 2s. 6d. per ton, is based.

But, as Mr. Tomlinson now shows, the actual product is only 18 tons, which makes the cost of delivering peat to the producer 6s. 7d. per ton.

We have seen that the peat as fed to producer is only 4,754 B.TH.U., and for any purpose, 3 lb. of this bulky fuel = 14,262 B.TH.U. is poorer value than 12,000 B.TH.U. in the concentrated form of a single pound of slack coal.

Therefore, leaving the electricity scheme out, slack coal at £1 per ton delivered would successfully compete with peat

at 6s. 7d.; and as the agreed cost of coal is 14s. ton, the peat is 30 per cent. inferior value.

Investors will, therefore, be well advised not to entertain any scheme for peat utilisation unless in countries where coal is exceedingly dear.

Charles Erith.

London, E.C., *January 6th*, 1908.

Address Wanted.—Will Mr. Daniel Shirt kindly oblige us by advising us of his present address?—Eds. E.R.

PROCEEDINGS OF INSTITUTIONS.

The Commercial Aspect of Electric Power Supply.

By W. B. Woodhouse.

The following contributions to the discussion came to hand too late for inclusion in our last issue:—

Mr. Geo. Wilkinson said that Mr. Woodhouse put his finger on the weak spot right away, viz., the unfortunate restrictive legislation which prejudicially affected the industry, and the marvel was that the British industry stood so well in the world to-day. The first table in the paper was one of cost of stations of different capacity. Unfortunately the portion referred to was simply the station equipment, and the much more serious problem for power companies, viz., the cost of the distributing mains, was omitted. Mr. Woodhouse put the cost for a 60,000-kw. station at £10 per kw.; £15 for 6,000, and £20 for 600. In his opinion it could not be done for that; it certainly would not be done for £20 per kw. for a 600-kw. station, unless they had a tin building. If it was a substantial building it would go up to something like £28. A 300-kw. set was put down as consuming 24 lb. of water per kw.-hour; he did not know whether this included the steam losses and the steam used in the auxiliaries, &c., but the figure certainly was heavy. He knew of a turbine, six years old, of 300 kw. capacity, which was consuming 19½ lb. of steam per kw.-hour on full load. The author stated that the consumption of coal was 3 lb. per kw.-hour, which meant an evaporation of 8 lb. of water to 1 lb. of coal, and that, in his opinion, was considerably too low, as it was quite easy now to get 9 to 9½ lb., so that instead of 3 lb. they would do it for 2 lb., unless the losses were increased owing to the steam set being too large for its duty. He did not know of any stations at present that were enjoying such load factors as 30 per cent. and 60 per cent. In the case of Harrogate they had approached a diversity factor of 2, and that was largely due to the fact that they had a peak load in the summer. Their heaviest load was in September, so that they got better distribution throughout the whole year. One point worthy of consideration was electric cooking. The diversity factor for cooking was likely to come out at something like 4, instead of 2, and that, of course, had a very material bearing on the price at which they could sell electricity for cooking, because the capital cost was the chief determining factor. If they could get electric cooking showing a diversity factor of anything like 4, they could afford to sell current at a price that could make the business financially successful. He had recently gone into a new scheme for heating 300 gallons of water per hour for two hours during the early morning each day by gas, electricity, and steam, and found that the continuous losses, due to radiation and condensation in the lengthy underground transmission pipes, put steam out of competition with electricity. The cost of gas came out at £80 per annum as against £50 for electricity, and the capital outlay as between steam and electricity, was £160 for electrical apparatus, as against £450 for steam. These were points that might well be considered, and he suggested that cooking and the heating of liquids were not outside the province of the electrical industry.

Mr. T. Harding Churton said Mr. Woodhouse had made a bold proposition in suggesting that the collieries in the West Riding should form a joint-stock concern of their electrical plant; not only did the difficulties in the way of adopting such a proposal seem to be great, but the advantage appeared questionable. The suggestion seemed to be that a colliery-owner, instead of installing a "stand-by" plant, was to be connected up to his neighbours' plant, upon which he could draw in the event of a breakdown to his own machinery. The difficulties in the way of managing such an arrangement appeared considerable, and in most cases the cost of the cable would be a great deal more than that of a "stand-by" plant. The cost of management at the colliery would not generally be reduced, as one man only was usually employed to mind the plant, whether there were two or three or more sets installed. Further, most colliery-owners appreciated the advantage of having control of their electrical supply. Generating costs at collieries, particularly those at which the waste heat from coke ovens was utilised, were usually very low, and he could not see where a colliery with its own generating plant could obtain any particular advantage from the proposed combination.

Prof. Barr said, referring to the same question, he was unable to understand where the economy would come in in such a case except under special conditions; if the peak of the load had to be taken in this way, machinery would have to be installed to take the peak, and a large increase of costs would occur in connection with the mains.

A Standard of Radio-Activity.

In the early part of 1906 the Röntgen Society appointed a Standards Committee to systematise as far as possible the various methods already in use for determining the dosage of X-rays, and, if possible, to establish a unit for the measurement of radio-activity. The work has been carried out largely in the laboratories of Lord Blythswood and Mr. C. E. S. Phillips. In the former the properties of the X-rays bearing on the problem have been investigated, and in the latter an effort has been made to obtain a radio-active standard. The Committee has been in touch with the Intensitats Commission of the Berlin Röntgen Society, as well as with similar societies in America and on the Continent.

At the last meeting of the Society on January 2nd an interim report was presented. It was laid down that the conditions essential to a radio-active standard were constancy and homogeneity. The study of the transformation products of radium showed that the α and β rays changed with time, but that the γ radiation might, for all practical purposes, be regarded as constant and nearly homogeneous. The Committee, therefore, recommended that 1 milligramme of pure radium bromide should be regarded as a standard, and that the ionisation produced by the γ rays from that quantity after passing through 1 cm. of lead, in order to cut off the inconstant α and β rays, should be taken as the measure of the unit of radio-activity. The Committee was of opinion that a fundamental c.g.s. unit of radio-activity was not at present feasible, but suggested that it might ultimately be possible to define the standard in c.g.s. units as that weight of radium which radiated energy at the rate of, say, 1 erg per second.

A number of interesting letters from well-known scientists were read at the meeting and revealed certain differences of opinion, principally on the question of the atomic weight of radium, the correct thickness of the lead screen to be used in filtering out the α and β rays, and the purity of radium preparations.

Prof. Silvanus Thompson asked whether no organic reaction could be made use of as at least an approximate test of possible therapeutic effect—whether there was no coloured organic substance which would give a reaction in presence of radium.

Sir William Ramsay wrote that according to experiments now being carried out at University College, it appeared probable that the atomic weight of radium exceeded 240. (Mme. Curie's estimate is 225 or 226.)

Prof. Rutherford suggested a lead screen thickness of 5 mm. instead of 1 cm., stating that the former thickness was sufficient to mask the inconstant rays, and would, at the same time, extend the lower limit of comparison of quantities of radium by this method.

A discussion ensued, in which Mr. C. E. S. Phillips, replying to some of the criticisms in the letters, said that the choice of 1 cm. screen thickness was made because 1 cm. was more easily expressed and remembered than a number of millimetres.

Mr. F. H. Glew questioned whether the Committee had done wisely in selecting radium as the standard of radio-activity. He suggested that uranium might have been chosen as it could be obtained in large quantities in a pure form, and gave the γ radiations.

Mr. W. Duddell, the President of the Society, said that any standard of radio-activity must be constant and capable of being reproduced. He suggested that a sub-standard in which permanency was not so essential, might be formed for practical use, and checked from time to time with the fundamental standard in the National Physical or some other laboratory, in the same way as the working standard in electricity was checked with the fundamental unit of the c.g.s. system at intervals.

The Province of the Illuminating Engineer.

By Leon Gaster.

(*Abstract of paper read before the* Association of Engineers-in-Charge *on December 11th*, 1907.)

Until the last few years the question of proper illumination has not received sufficient recognition as being of any special interest or concern of the gas or electrical central station engineer; his business has been to supply gas or electric energy to the consumer, but not illumination, and it was left to the consumer to do the best he could with the illuminant adopted. Needless to say, the result in most cases was very poor indeed.

The difference between light and illumination may be defined: Light is the cause, and illumination is the effect. An object on which light falls becomes illuminated, and an object is well illuminated when it can be easily seen without fatigue or strain on the eyes. Good illumination requires, therefore, amongst other conditions, sufficient light to enable one to see clearly and distinctly; avoidance of too much light, which produces a blinding and fatiguing effect on the eyes; avoidance of having a bright light in the field of vision, which cuts down the ability to see clearly things which are less brilliantly illuminated; avoidance of glare due to the light striking an object at such an angle that a large part of the light is reflected directly to the eyes, &c. It will be seen, therefore, that in considering any form of illumination it is absolutely necessary to take into consideration the effect on the eyes. There is, however, also the æsthetic aspect of illumination to be considered, which has not received, in many cases, the attention

it deserves. On account of the enormous improvements which have been made during recent years with the different illuminants, the proper application of the above-named principles has somewhat taxed the ordinary lighting contractor, and therefore a great deal of discussion has taken place in the technical Press as to the advisability of establishing a new specialist, to be called "The Illuminating Engineer." He will have to deal with gas, electricity, oil, acetylene, &c., and know how to make the best use of any or all of them. He must possess a sound grounding in physics and chemistry, and some knowledge of physiological optics, he must be well up in the science and art of photometry, and, above all, he must have a lively sense of the artistic. The illuminating engineer will have to be possessed of great tact and enormous persuasive powers to wean us from such choice as an artistic, but foolish fitting.

Until recently the engineer who wished to lay out the lighting of a building had not sufficient definite rules or formulæ available. The distribution and intensity of illumination, in the neighbourhood of a single source of light, can be easily calculated by well-known methods, and plotted in the form of a curve. When, however, the illumination is the result of several sources of light in different directions, the question becomes more complicated, and the difficulty is further increased when the diffusion from the walls, &c., of an enclosure has to be considered. The illumination of a room or other enclosure may be divided into two factors —that derived from the direct radiation from the source of light, and the diffused light resulting from the combined reflection from the surrounding surfaces, and this varies very considerably.

Light and its effect, illumination, having to do with the eyes, are peculiarly subject to fallacious misunderstandings. The new light sources are excessively intense or bright. Take the incandescent electric lamp for example. If you look at such a lamp when it is burning, the image of the filament on the retina is so intensely brilliant that if you cover your eyes with the hand you will continue to see the bright form of the filament floating in a dark field for some time. This shows that the excessive brilliancy of the image strained that part of the retina upon which it fell, so that it required some time to recover. If the strain were continued long enough, the injury would become permanent. There are cases on record where total loss of sight has resulted from such a strain. It may be put down as an established fact in artificial lighting that all modern light sources are too bright to be used uncovered. While the light is to be used for careful vision, such as reading or writing, it should either be enclosed in some sort of globe which will produce a diffused light, or be placed so that the eye cannot see the source of light. If this rule is adhered to, it will be found that none of the modern high power lights are too hard on the eyes. It was with a view of avoiding serious waste of light that the Holophane globes have been invented. These globes are made of the purest crystal glass, having both inner and outer surface formed into series of prismatic rays and flutings accurate to the thousandth part of an inch. These prisms are of such forms as to soften and diffuse the light, and at the same time turn the rays into a useful direction. This is accomplished by forming the prisms in accordance with the established laws of optics. While throwing the larger part of the light in the direction required for special use, they allow a sufficient amount to shine in other directions to produce a soft and pleasing general illumination effect. The artistic and decorative effect of the globes and shades used in the home, must also be considered as carefully as their utility.

The average factory requires artificial lighting during 10 to 20 per cent. of the working hours, not including overtime or night work. Therefore the illumination should be sufficient, and the lamps so arranged that the quality and quantity of work accomplished during these hours should be as well done as that which is performed by daylight. The amount of light required varies with the size of the room, relative positions of machines, the general shop conditions, and to a very great extent with the character of work to be done. Is there a more exaggerated case of false economy than that of requiring people to work by poor illumination? In comparison with the cost of labour the cost of light is trifling. Take as an illustration the case of a skilled workman, receiving 8s. to 10s. a day—about 1s. an hour. Figure the cost of energy used by a 16-c.p. lamp burning 10 hours, and see how much of the man's time it requires to pay for the light (if current is available at 1d. per unit, it works out at less than ½d.). Yet there are thousands of skilled mechanics handicapped by insufficient and ill-directed light. In the case of bad lighting in a factory or workshop, the personal inconvenience means a reduction both in quality and quantity of the output, thus producing a loss to which in comparison the entire cost of illumination is trifling. In many cases a lighting installation which would be adequate if properly maintained, is allowed to run down and become seriously defective for lack of care. Very often one sees electric lamps and reflectors taken from machine shops with the reflector absolutely black from accumulated soot and grease, and the lamp showing hardly any light on account of age. The maintenance of the lighting system should not be left to the individual workman.

Mr. W. H. Patchell, in his presidential address before your Association, remarked that good illumination is conducive to economy in both engine and boiler rooms, as plant in a badly-lit room never gets properly looked after or cleaned. Why should it? asked Mr. Patchell, as no credit is given to the cleaner if it cannot be seen. Dirt is about the worst disease a plant can suffer from, as it invariably means neglect of small indications and warnings, timely attention to which would prevent the otherwise inevitable breakdown.

There is, perhaps, no case in which light is so ineffectively squandered as in the lighting of the shop windows in our streets. It is not too much to say that one cannot walk down the best streets of London without constantly seeing light not only wasted, but actually defeating its own object. Brilliant lights are frequently distributed either in the front of the window or among the contents of it, in such a way that the prospective customer cannot gaze into the window without discomfort. This illumination seems to have arisen through a confusion between two separate and distinct objects, which the illumination of shop premises has in view: First, to attract the attention of the purchaser, and, secondly, to exhibit the contents of the shop window to him, when he has been attracted. Unfortunately the two objects are not kept distinct. The salesman who crowds a row of flame arcs or intense gas incandescent lights into a frontage of about 20 ft., and fills his window with naked glow lamps with the object of attracting customers, also paralyses their power of observation when they have arrived. If intense brilliancy is to serve as an attraction, this intense light should be arranged so as to be only visible to the destined customer, and not to obstruct his view of the window.

The same confusion as to the exact purpose for which the light is installed, and the same defect of placing brilliant sources of light between the observer and the objects they are intended to illuminate, is apparent everywhere. I will only draw attention to another example—the very unsatisfactory methods of illumination in use at many libraries. The lights are often so arranged as to brilliantly illuminate the gangway, where in reality only sufficient illumination is desired to find our way about in comfort, and the illumination of the reading tables is less than insufficient. In a library, light should serve three chief purposes: it should enable the worker to read, it should illuminate the shelves of books so that the titles are easily recognisable, and it should also, of course, illuminate the surroundings with a subdued illumination, sufficiently strong, however, to enable the reader to find his way about. The illuminating engineer can do much useful work to improve matters.

The enormous progress which is constantly being made with the different methods of illumination creates the necessity for a closer study of the relative merits and faults of the methods employed. It is not hereby meant that the illuminating engineer, as a specialist, is to be called in for every little lighting installation, but his services will be more important in assisting the architect and the consumer, not only in the selection of the proper type of lamp to be used, but also to advise impartially as to the proper method of illumination to be adopted to give the best results from every point of view.

During my visit to the States I was given to understand that when the illuminating engineer specialist started he was received somewhat with suspicion, but did not take long to receive due recognition. To-day, we not only see the architect taking advantage of his services by working with him, but even the Government has given him recognition by appointing an independent expert to act as illuminating engineer for the Congress building, and for the public libraries one has been appointed to assist the architect on all the illuminating questions.

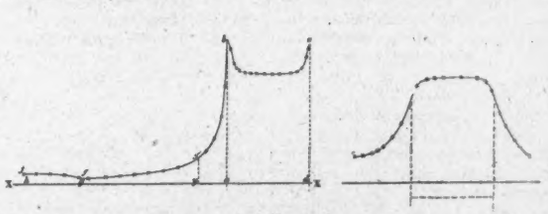
The Reluctance of the Air-Gap in Dynamo Machines.

By T. F. Wall, M.Sc., B.Eng.

(Abstract of paper read before the Institution of Electrical Engineers *at Manchester, December 10th, 1907.)*

The author gives the results of experiments carried out last year in the Electrotechnical Institute, Karlsruhe, with a view to finding the increase of reluctance of the air-gap due to slotting the armature core.

The flux distribution over the surface and flanks of a rectangular polar projection is shown in fig. 1, x x representing the developed surface of the pole-piece; thus the part $a\,b\,c\,d$ gives the flux issuing from the polar surface, $a\,b\,f\,g$ the flux issuing from the pole flank and $f\,g\,k\,j$ the flux from part of the root of the gap between the poles. The peak at each pole-tip, where the flux is evidently much denser than at the middle of the polar surface, resembles that observed in an electrostatic field.

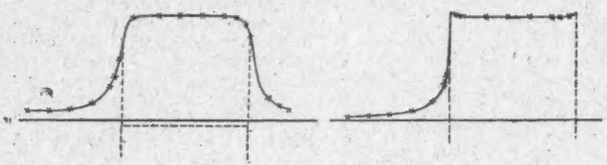


Figs. 1 and 2.—Flux Distribution on Pole Face and Flank, and on Armature Surface.—Air-gap = 1 cm. Width of pole face = 5·8 cm. Length of pole face = 11 cm. Average flux density over pole surface = 16,000 lines per cm².

Similarly fig. 2 shows the flux distribution over the smooth surface of the armature corresponding to fig. 1. The ratio, width of pole: length of air-gap = 0·8.

With a smaller air-gap, and a less flux density, the peaks at the pole tips were less noticeable (figs. 3 and 4, p. 50). It will be observed that with a large gap the maximum flux density on the pole-face is greater than on the armature surface, while with a small gap it is about equal in both cases. Ratio of width of pole: length of air-gap = 25·2 in figs. 3 and 4.

Substituting a slotted armature for the smooth core, the flux density over the pole surface was found to vary considerably opposite the teeth and slots, as shown in fig. 5, in which the ratio slot : gap was 6·5, and the ratios tooth-width : gap were respectively 4·35, 6·51, 6·66, 8·48, 8·52 and 13·05, the teeth being graduated so as to cover a wide range of conditions.



Figs. 3 and 4.—Flux Distribution.—Air-gap = 2·3 mm. Width of pole-face = 5·8 cm. Average flux density on pole surface = 5,000.

Under the same conditions fig. 6 shows the distribution of the flux over the surfaces and flanks of the teeth. It is noticeable that the density at the edges of the teeth is greater than in the middle, and that the latter is greater than at the opposite point of

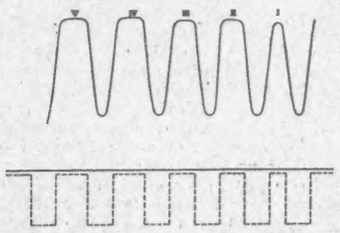


Fig. 5.—Flux Distribution on Smooth Surface of Pole-piece.—Air-gap = 2·3 mm. Average flux density under a tooth = 5,000.

the pole-piece. The effect of increasing the air-gap was found to be to smooth the fluctuations of the flux in the pole surface, while increasing the peaks at the edges of the teeth. Increasing the flux density also increased the peaks, and accentuated the peaks at the tooth-edges.

The author applies the results to the calculation of the air-gap ampere-turns.

Denoting the ratio of the ampere-turns required to send a given flux through the air-gap with a slotted armature to the number necessary with a smooth armature by k_1, Arnold states that $k_1 = t_1 \div (z_1 + x\,\delta)$, where t_1 is the slot-pitch ; z_1 is the width of tooth at the

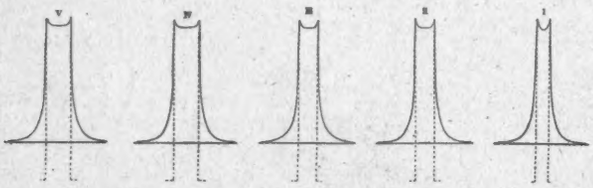


Fig. 6.—Flux Distribution over Teeth.

circumference of the armature ; x is a factor dependent on the ratio slot : gap, and δ is the length of the air-gap. The relation of x to v, where v = slot : gap, is shown dotted in fig. 7. The value of x can be deduced from the author's results, as k_1 = maximum flux density in air-gap : mean flux density in air-gap ; the former being taken as the mean of the flux density at middle of the surface of a tooth and

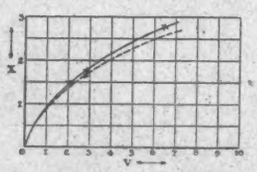


Fig. 7.—Relation of x to Slot : Gap.

the maximum flux density at the surface of the pole surface just opposite. The full line curve in fig. 7 shows the experimental results for the value of x.

The application to induction motors is also considered. In this case both stator and rotor are slotted, and the distribution of flux is very complex and constantly changing. The author suggests that the coefficient k_1 be determined for the case when the rotor is slotted and the stator smooth ; next, that a coefficient k_2 be similarly calculated for the case when the stator is slotted and the rotor smooth. Then the coefficient to be used when both stator and rotor are slotted will be given without any great error by the product $k_1 k_2$.

POWER REQUIRED TO DRIVE INDIVIDUAL MACHINE TOOLS.*

By H. B. EMERSON.

In years past, when shops used no better tool steel than mushet, it was fairly easy to state what power would be required to drive a certain tool ; but now new conditions have arisen, cutting speeds have been attained which were never before thought of, competition and the great demand for finished products have caused the manufacturers to work every machine to the utmost. No hard and fast rule can be set forth to meet all cases, as the power required varies with the kind of metal worked, with the kind of tool steel and machine used, with the shape and size of the chip removed, with the cutting speed and with several other conditions, which are bound to vary with different usage. Neither can a person state with accuracy that it requires a certain size of motor for a given tool, because the duty required of that tool in one shop or factory may be more severe than in another. For example, a 36-in. lathe used in one shop for roughing shafting of low-carbon steel, where they use two cutting tools, reduces the diameter of the shaft $\frac{3}{8}$ in. per cut, with $\frac{1}{4}$-in. feed and a cutting speed of 150 ft. per min., and will require, approximately, a 25-h.p. motor to run it. In another shop the same size of lathe may be used for finishing and other light work, and will require perhaps a 3-h.p., but never more than a 5-h.p. motor to drive it under any condition. In large factories, or in those factories having keen competition, the tools are worked to their utmost ; while in repair shops and small factories, where the conditions are entirely different, the service of the tools is much less severe and in general requires much less power to drive them.

Horse-Power for Drills.

Sensitive drills	½ H.P.
12-in. to 20-in. upright drills	1 „
20-in. to 24-in. upright drills	1½ „
26-in. to 30-in. upright drills	2½ „
30-in. to 40-in. upright drills	3½ „
36-in. to 40-in. radial drills	1½ „
4-ft. to 5-ft. radial drills	2 „
6-ft. to 8-ft. radial drills	3 to 5 „

Horse-Power for Lathes.

Speed lathes	1 H.P.
22-in. and 24-in. engine lathes	2 „
26-in. and 30-in. engine lathes	2½ „
36-in. and 42-in. engine lathes	3½ „
48-in. and 54-in. engine lathes	5 „
60-in. engine lathes	6 „
72-in. engine lathes	7½ „
84-in. engine lathes	10 „

Horse-Power for Heavy-Duty Lathes.

24-in. to 30-in. lathes	15 H.P.
36-in. to 48-in. lathes	20 „
54-in. to 72-in. lathes	25 „

Horse-power for Boring Mills.

37-in. boring mill	4 H.P.
51-in. boring mill	5 „
5-ft. boring mill	6 „
6-ft. boring mill	7½ „
7-ft. to 9-ft. boring mill	10 „
10-ft. boring mill	12 „
12-ft. to 16-ft. boring mills	15 „
16-ft. to 25-ft. boring mills	18 „

Horse-power for Planers.

20 × 20-in. × 6-ft. single-head planer	3½ H.P.
30 × 30-in. × 8-ft. single-head planer	5 „
42 × 42-in. × 10-ft. single-head planer	7½ „
60 × 60-in. × 12-ft. double-head planer	10 „
72 × 72-in. × 14-ft. double-head planer	15 „
84 × 84-in. × 18-ft. double-head planer	20 „
9 × 10 × 24-ft. double-head planer	30 „
12 × 12 × 24-ft. double-head planer	40 „

Horse-power for Crank Slotters.

12 in. stroke	5 H.P.
18-in. stroke	7½ „
24-in. stroke	10 „
30-in. stroke	10 „

Horse-power for Shapers.*

16-in. stroke	2 H.P.
24-in. stroke	3 „
30-in. stroke	5 „

* Single-head machines.

Horse-power for Horizontal Milling Machines.

24 in. between housings	7½ H.P.
36 in. between housings	10 „
42 in. between housings	15 „
4 to 6 ft. between housings	15 to 20 „

* *American Machinist.*

From the foregoing facts it will be readily seen why no accurate data have been published. The writer, however, after making many tests of the power required to drive machine tools, has gathered some data which may be of use to many readers if used with judgment; for the duty in general required of machine tools in small factories, repair shops and the like, the accompanying horse-powers for the various machine tools will be found to be approximately correct.

The powers are the average results from a great many tests of individually driven machines working under general machine-shop duty; if tools are to be grouped, 40 to 85 per cent of the above powers may be used to figure the proper capacity of the motor or engine which will be used to drive the group, using a higher or lower percentage according to the total number of machines which will be used under maximum duty at any one time.

ELECTRICAL EXHIBITS AT THE PARIS MOTOR-CAR SHOW.

(*Continued from page* 11.)

The Krieger Electric Carriages.—La Compagnie Parisienne de Voitures Electriques Procédés Krieger, of Colombes and Paris, are among the oldest builders of electrical vehicles in France, the first car having been turned out so long ago as 1894. Their chassis (fig. 7) is so built that any form of town carriage body can

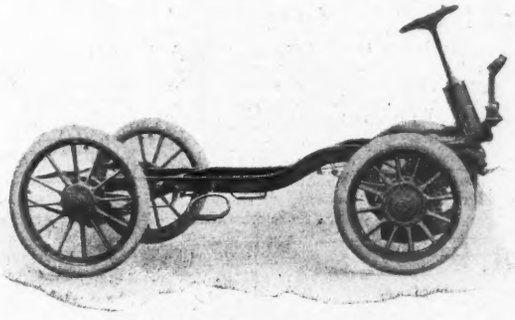


FIG. 7.—KRIEGER CHASSIS.

be fitted. Two motors are employed, one for each of the front road wheels, which thus act both as steerers and drivers, the transmission being through enclosed helical gearing (fig. 8). On the collector side of the motor is a large detachable cover, which enables the collector and brushes to be readily inspected. On descending a hill, the momentum of the car rotates the motor armatures, and the current generated is utilised for recharging the batteries, effecting a very considerable economy by utilising the power that would otherwise be uselessly expended in heat, were an ordinary

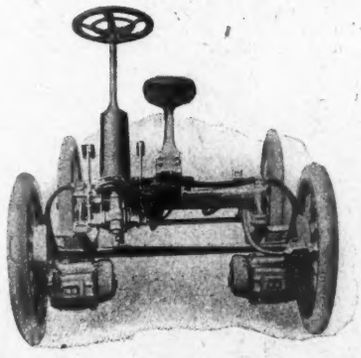


FIG. 8.—MOTORS AND CONTROLLER, KRIEGER CHASSIS.

brake employed. Starting and stopping is controlled by a pedal, which allows of a progressive start by passing the current through a rheostat. The varying speeds of the car, as also the electric brake and the reverse motion are obtained by means of a controller formed round the steering column, so acting as a support to the latter. The lever can be placed in different positions as follows:—(1) Reverse motion; (2) electric brake; (3) neutral; (4) first forward speed; (5) second speed; (6) battery recuperation at 40 volts; (7) hill climbing speed; (8) third speed; (9) battery recuperation at 80 volts; (10) fourth speed; and (11) top speed. The battery of accumulators is carried in one or two groups, according to the type of car; the whole of the wires are highly insulated, and so fixed as to be accessible throughout their entire length. The connections are made by fixed terminals with nuts and lock-nuts, which ensure good contact and insulation and also permit rapid changes of the whole or part of the wiring. The weight of a car is about 17¼ cwt., to which has to be added that of the battery, which for average runs of 43 miles on one charge weighs 10 cwt. A larger number of accumulators can be carried, increasing, of course, the weight and the mileage.

As regards prices, a single landaulet is listed at £720, and a two-seated coupé at £688. In addition, however, to selling cars outright, the Krieger Electrical Carriage Syndicate, Ltd., who handle the Krieger vehicles in this country, and whose garage is located in Gillingham Street, Victoria, S.W., is devoting special attention to the hiring of cars—a department which was inaugurated early in 1903. The vehicles are mainly used in London as town carriages, but they are frequently sent out as far as Staines, Windsor, Harrow, &c., on one charge. The hiring tariff is a very complete one, ranging from a single morning or evening to a complete year. For six months' hire and under there are two scales, one for the summer and one for the winter season, three months in the summer costing £270, as against £180 for a similar period in the winter. For a period of nine months the cost of hiring a carriage is £495, and for a whole year £600.

The Gallia Electric Carriages.—The Gallia electric vehicles (fig. 9), which are largely used in Paris, are made by La Societé L'Electrique, whose garage is at 17, Rue Jean-Goujon, Paris, and the works at Rue Gravel, Levallois-Perret. Two motors are

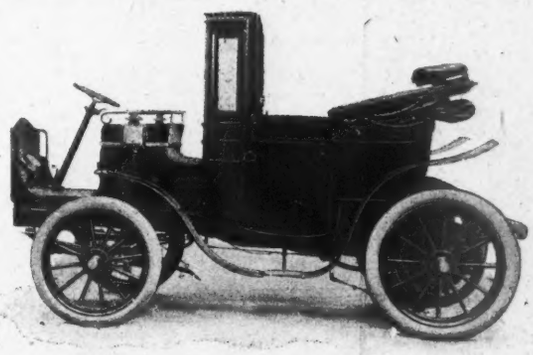


FIG. 9.—GALLIA ELECTRIC CARRIAGE.

employed—one for each of the rear road wheels; they are of the enclosed compound type, and transmit the power developed to the rear road wheels through spur gearing (fig. 11). The suspension of the motors is on special lines; they are free to oscillate on a horizontal shaft, and are in addition provided with an arrangement which allows of their free movement, within certain limits, independent of any jolting to which the frame may be subjected. The electric conductors, while well protected from damp and dirt, are so

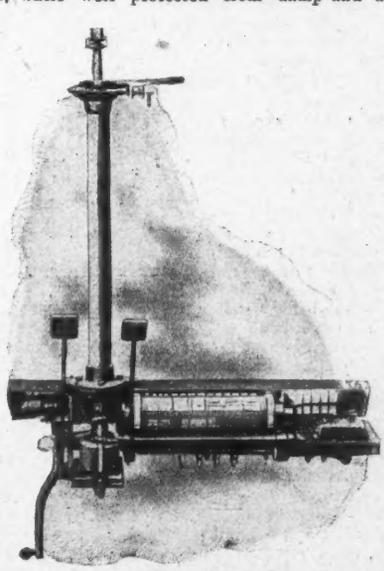


FIG. 10.—CONTROLLER, GALLIA ELECTRIC CARRIAGE.

arranged as to be readily accessible. The battery, the capacity of which varies from 140 to 240 ampere-hours, according to the particular vehicle, is divided into two groups, one being located in the front and the other in the rear of the body; they are of a special type, and are referred to below. As the makers point out, the mileage on one charge varies in accordance with the condition and gradients of the roads traversed, on the average speed maintained and the number of starts and stoppages. Under average conditions, a distance of from 36 to 50

miles can, however, be covered on a single charge. The controller is of a simple design; it is of relatively large size in order to allow contacts of ample area to be employed. In addition to a neutral and reverse position, it is adapted to give six forward speeds and two electric brakes, with, at the same time, battery recuperation. Starting is effected by means of a pedal, while the different speeds

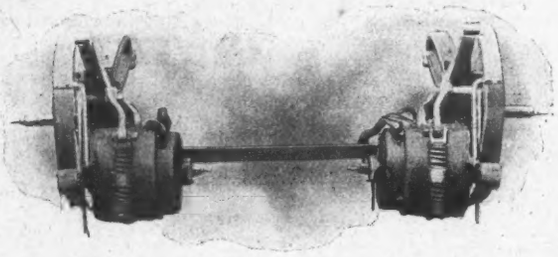


Fig. 11.—Suspension of Motors, Gallia Carriage.

are controlled by a hand lever (fig. 10). In addition to the braking effect obtained with the electric motors, two powerful mechanical brakes, operated by hand and foot levers respectively, are provided, both being so arranged that on being applied the current to the motors is first cut off.

The Electrique Co. is also building a series of light two or three-seated vehicles, which can be fitted with either closed or open bodies. In these cars, which are known as the "Galliette," only a single motor is used, this being located at about the centre of the frame and driving the rear live axle through a cardan shaft and bevel gear. The electrical energy is furnished by a battery of 48 cells of 110 ampere-hour capacity, sufficient for a run of about 30 miles on one charge at an average speed of 12 miles per hour. The motor, of the series variety, has an armature of the Siemens type, and special attention has been paid to the carbon brushes and their holders to render them accessible. The cost of the chassis is £300, while for an additional £60 it can be equipped with a luxuriously finished body of the victoria pattern.

The accumulators employed on the Gallia and Galliette vehicles are known as the "Ajapa," and are of the company's own manufacture. The grids are of a special design, the square recesses being provided with diagonal bars, set in different planes in order to securely fix the active material. It is claimed that not only is the specific capacity high—12 to 14 ampere-hours per kilogramme of cell—but that the positive plates have a life fully equal to that of the negatives; the accumulator is capable, too, it is stated, of withstanding charging and discharging rates twice to three times the normal. Three sizes of batteries are made; No. 1 is of 140 ampere-hour capacity at a discharge rate of 18 amperes for five hours; it comprises 46 cells, each containing 21 plates 10 cm. × 19 cm., the weight complete of the battery being from 600 to 650 kg. No. 2 has a capacity of 175 ampere-hours at a discharge rate of 35 amperes for five hours. The cells—46 in number—comprise 17 plates 16½ cm. × 19 cm., the approximate total weight being 750 kg. The capacity of No. 3 battery is 240 ampere-hours at 48 amperes for five hours discharge rate. There are 17 plates, 20 cm. × 19 cm., per cell, the weight complete being from 850 to 875 kg.

The Mercedes Electric and Petrol-Electric Cars.—The Mercedes electric and petrol-electric vehicles which were on view at the Paris Show are handled in this country by Mercedes-Mixte, Ltd., of 11A, Regent Street, London, W. The system adopted on these cars has already been described in the Electrical Review, but it may be briefly mentioned that in the combination vehicles the prime mover consists of a four-cylinder engine, located in the usual way under a bonnet in the fore part of the frame. In place of the clutch and gear-box of the ordinary petrol car, a small dynamo is mounted on an extension of the crankshaft of the engine, the current generated being transmitted to a lever-actuated controller of the type used on electric motor-cars and thence by two cables to two series-wound motors, the latter being built up in the hubs of the rear road wheels. The motor shell forms the wheel hub proper, and is itself formed with a central bearing, receiving the axle upon which the road wheel rotates. Each armature is keyed to the hollowed axle through which the cable is threaded and secured by a nut and lock nut, while around the armature, and solid with the shell, are the fields. These rotate to turn the wheels when the current is transmitted, series fashion, to the armature, the commutator and spider on which the contact brushes are fixed being inside the hub-plate on the outer side of the wheel. This plate is secured by screws, the removal of which exposes the commutator and brushes, which can thus, if necessary, be examined in a very few minutes. Furthermore, either motor can be removed from the wheel with but little difficulty. It is claimed that the motors are able to develop a relatively high power for their size and weight, this being due to the fact that the fields revolve about the armature, instead of the latter rotating within the former, the result being a comparatively low tangential speed for the fields and a high output of power for the current received.

The effect of the complete absence of the usual gear box, clutch, gears, shafting, and all mechanism for transmitting power and changing speed, is that the car runs perfectly smoothly, with no vibration, and with no noise other than that arising from the engine, which is barely perceptible. Changes of speed are effected by the smooth and silent action of the controller altering the electrical connections, three forward and one reverse speeds being available, as well as two electric brake positions. The engine speed is independent of that of the car, and it can be run at the rate which most economically develops the power required. This is particularly useful when the car encounters steep gradients, heavy roads, and frequent traffic obstruction. A special feature of the dynamo is that it gives an automatic limit to the current strength, and thereby prevents either the electrical machinery being overloaded or the engine being pulled up. As the speed changes are made without interrupting the connection between the engine and the driving wheels, no loss of speed or power occurs at these changes, as is the case with the ordinary petrol car.

No accumulators are employed in the Mercédés-Mixte system, and, as the hub-motors are independent of each other, this forms another advantage claimed for the system, in that it obviates the use of the usual differential gear. The braking system is also interesting. The mechanical brakes, actuated respectively by a pedal and a hand lever, are in no way different from the internal-expanding band types used on ordinary petrol cars. It may be noted, however, that as the pedal brake comes into action it operates a switch which cuts off the current, for the time being, from the dynamo to the motors. In case of failure of the mechanical brakes, an electric brake may be immediately constituted, with the whole power of the petrol-motor behind it, by simply reversing the current to the motors from the dynamo by moving the lever to the reverse position. Great hill-climbing efficiency is claimed for the system, for the engine can be run at its maximum speed, the dynamo and electric motors being designed to take this without being overloaded.

The Mercédés-Mixte Co. are also building electric carriages in which the hub system of electric motors is employed, the necessary current being, in this case, furnished by a battery of 42 Tudor accumulators arranged under the front and rear seats. A feature of the vehicle is the provision of a new regenerative controller, by means of which, whenever it is desired to stop the car, or when running downhill, when the motors are being driven by the motion of the car itself, the latter are automatically converted into dynamos, the current generated going back into the battery. Not only does this intermittent recharging very much increase the distance that the car will run on a single charge, but the frequent replenishing of the battery is beneficial to its life, apart from the distance run. At the same time a powerful braking action is made available when the motors are used as generators. We may add that one of these vehicles recently made a run of 64 miles on one charge under the observation of the Royal Automobile Club.

(To be continued.)

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Small Transformers.

Messrs. Ferranti, Ltd., have recently placed on the market two lines of small transformers ranging up to 25 kw.; these transformers are of the core type. The coils are wound independently of the core, being slipped upon the latter. Each coil is dried and separately impregnated in a vacuum drying apparatus. An illustration of such taped and impregnated coils is given in fig. 1. It is considered that this method of transformer manufacture is preferable to the shell type of transformer, especially for export orders, having regard to the ease with which transformers thus constructed can be repaired when any accident necessitates this. The type

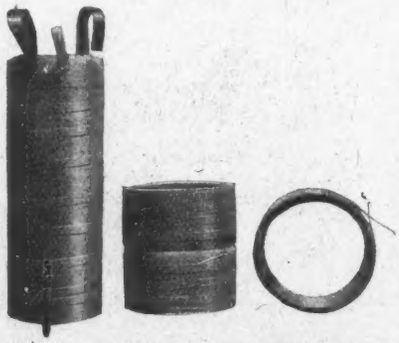


Fig. 1.—Coils for Ferranti Type P Transformers.

"P" transformer is specially designed with a rain-proof tank for hanging on poles, which is illustrated in fig. 2. A considerable number of these transformers, we understand, have been shipped to South America.

It was found, in endeavouring to export transformers to such countries as Russia, where there is a 70 per cent. import duty, based upon the weight of the article, that transformers of low efficiency had an advantage as compared with high-efficiency transformers, owing to their lighter weight. It is quite

evident that with a heavy import duty such as this, the most economical design for use in such a country is different to the most economical design for use in this country, consideration being in each case taken for the total cost, viz., interest and depreciation on

Fig. 2.

the cost price on the one hand, and the total amount of energy lost in the transformer per annum on the other. The type "E X" transformer has been got out to combine a high efficiency with a minimum weight. It is found that these transformers, which have a

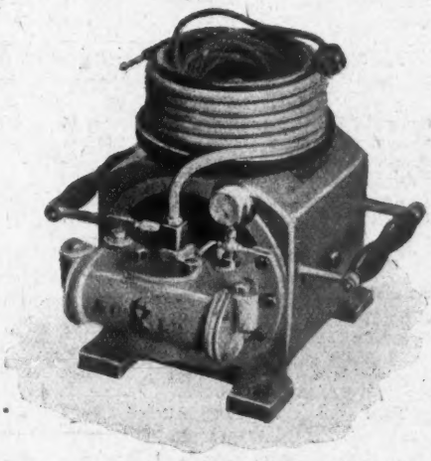


Fig. 3.—New Type Reavell Portable Air-Compressor.

very much better efficiency than transformers of the same size hitherto imported into Russia from Germany and other places, still do not show a too great increase in the cost price. As regards the ultimate cost, they are, of course, very much superior. The electrical particulars of the type "E X" transformers are given below:—

Electrical Table of Type "E X" Transformers.

K.V.A.	No load loss or magnetising watts.	Regulation cos ϕ 1.	Efficiencies at various loads.				Weight in	
			1/1	¾	½	¼	lb.	kg.
2½	40	2·9 %	95·8	96·0	95·6	93·3	180	82
10	101	1·95 %	97·2	97·3	97·1	95·7	655	295
15	142	1·7 %	97·5	97·6	97·4	96·0	760	344

The insulation tests which the transformers satisfactorily passed are as follows:—

Primary to secondary and core: Three times working pressure for 30 minutes.

Induced across the primary: One and a half times working pressure for 3 minutes.

Secondary to core: Five times working pressure for 3 minutes.

The insulation resistances were measured after the high-tension strain tests were made, the ohmmeter having a 1,000-volt generator, and indicating an insulation resistance of "infinity."

New Portable Air-Compressor.

Within the last few months Messrs. Reavell & Co., Ltd., of Ipswich, have introduced a considerable improvement in the construction of their small compressors of the type which has found such favour with central-station engineers for cleaning purposes.

The new type, shown in fig. 3, represents a saving in both weight and cost over its predecessors, the advantage being obtained through the adoption of a new gear for converting rotary into reciprocating motion, devised by Mr. Reavell.

In this gear, which is exceedingly compact, the small crank-pin on the motor shaft turns in a transverse cylindrical slide block, which in turn conveys a reciprocating motion to the double ended plunger. The compressor is fitted with ball suction and delivery valves, pressure gauge, relief valve, and a considerable length of rubber hose terminating in a suitable nozzle. The lubrication is automatic, an oil reservoir being provided under the cylinder casting; the plunger motion can also be inspected by removing a cover.

Messrs. Reavell are now fitting a comparatively light slow-speed motor to these small compressors, which weigh only 160 lb., and are therefore easily handled by two men. The machines are designed to work up to 30 lb. pressure, and their compact arrangement, with hose, flexible and handles, can be appreciated from our view.

BUSINESS NOTES.

Crompton's Xmas Entertainment.—At the Corn Exchange, Chelmsford, on Saturday last, upwards of 1,100 persons, consisting of the wives and children of the members of the Arc Works Club, were entertained by the generosity of the directors of Messrs. Crompton & Co., Ltd. Among these present were Colonel and Mrs. Crompton, Miss Crompton, Mr. and Mrs. Claud Crompton, Mr. Bernard Gibson, Lady Gooch, the Mayor and Mayoress of Chelmsford, Mr. A. J. Hodgson (works manager), &c. After tea, an attractive entertainment programme was carried out, followed by a baby show and competition. Votes of thanks to the directors were heartily accorded, and Christmas trees, toys and other things dear to the heart of the Arc Works children, concluded a successful and enjoyable evening.

The Franco-British Exhibition. — Mr. C. S. Northcote has sent us a list of 21 firms who have agreed to take part in the scheme for a co-operative electrical exhibit at the Franco-British Exhibition. We understand that full details are being prepared for circulation to the trade at an early date, but in the meantime Mr. Northcote will be pleased to hear from any others among our readers who desire to support the movement.

"Reyrolle" Annual Dinner.—On December 31st, the employés of Messrs. A. Reyrolle & Co., Ltd., Hebburn, held their fifth annual dinner. Mr. Reyrolle occupied the chair, with Mr. Coates as vice. The toast of "The Firm" was proposed by Mr. Pyle, and responded to by Mr. Reyrolle and Mr. Herbert Merz. The former remarked that they had had an extremely busy year. It was his ambition to make a name for the firm for good workmanship, the result of which would reflect, not only upon the firm, but upon all who were associated with it. Mr. Clothier proposed the toast to the organisers of the dinner, which he was sure would strengthen the good feeling amongst the staff and other employés. The musical entertainment provided was very enjoyable.

Croydon Tramways Benefit Society.—The annual general meeting in connection with the above Society was held at midnight on December 21st; Mr. T. B. Goodyer, tramway manager (president) was in the chair, supported by Dr. F. G. Grapel, medical officer to the Society. The contributions to the Society are based on a weekly payment of 1s. 1d., which entitles members to sick pay allowance at the rate of 20s. per week for a period of 13 weeks, and also to free medical attendance. In reviewing the work of the Society during the year, the president stated that the audited accounts showed the total contributions to have amounted to £472 10s. 2½d. The expenses were:—Sick pay allowance, £85 6s. 8d.; medical officer's fees, £31 14s.; refunded to members withdrawing, £7 2s.; death grant, £8; and incidental expenses, £9 2s. 3d., allowing of a share out of £2 1s. 10d. to 154 full members and of 19s. 4d. to nine part members. Satisfaction was expressed at the result of the year's working, and the whole of the officers and Committee were unanimously re-elected. The customary vote of thanks was awarded to the president.

The annual dinner of the engineering staff of the Croydon Corporation Tramways was held at the Wheatsheaf Hotel on December 14th. Mr. H. B. Harris, the tramways engineer, presided, and an enjoyable evening was spent.

New Journal.—Amongst the collection of seasonal compliments and New Year announcements received this week is an intimation that in this very cold month of January a new paper is to appear, bearing the title *The Illuminating Engineer*, a monthly shilling scientific journal of illumination, to be edited by Mr. Leon Gaster, and published by the Illuminating Engineering Publishing

Co., Ltd., of 13, Bream's Buildings, London, E.C. Since writing the foregoing, a copy of the paper has come to hand.

Trade Statistics of Chile for 1906.—The following statistics, showing the imports of electrical and other goods into Chile during 1906, are taken from the recently issued trade statistics; the figures for the previous year are also given for purposes of comparison, increases and decreases being added:—

	1905. Pesos.	1906. Pesos.	Increase or decrease. Pesos.
Iron Wire, including that for Electric Transmission Purposes—			
From Great Britain ...	17,169	163,746	+ 146,577
„ Germany	47,115	96,009	+ 48,894
„ France	4,983	3,522	− 1,461
„ United States ...	10,797	66,024	+ 55,227
„ Other countries ...	189	—	− 189
Total	80,253	329,301	+ 249,048
Cable Iron for Submarine Telegraph—			
From Great Britain ...	Not shown	10,000	—
Total	—	10,000	—
Lamps for Gas or Electricity—			
From Great Britain ...	5,088	8,589	+ 3,501
„ Germany	7,961	17,180	+ 9,219
„ France	108	7,186	+ 7,078
„ United States ...	5,124	4,288	− 836
„ Other countries ...	336	—	− 336
Total	18,617	37,243	+ 18,626
Gas or Electric Meters—			
From Great Britain ...	27,904	37,188	+ 9,284
„ Germany	3,264	2,440	− 824
„ United States ...	12	816	+ 804
Total	31,180	40,444	+ 9,264
Rails for Railways, &c.—			
From Great Britain ...	1,523,592	1,265,518	− 258,074
„ Germany	504,580	405,638	− 98,942
„ France	1,440	110,952	+ 109,512
„ Belgium	371,950	127,942	− 244,008
„ Holland	—	52,184	+ 52,184
„ United States ...	38,984	51,048	+ 12,064
Total	2,440,546	2,013,282	− 427,264
Bronze, Copper, or Lead Wire—			
From Great Britain ...	8,233	27,285	+ 19,052
„ Germany	118,675	119,147	+ 472
„ France	1,843	730	− 1,113
„ United States ...	11,913	29,541	+ 17,628
„ Other countries ...	308	317	+ 9
Total	140,972	177,020	+ 36,048
Glass Insulators—			
From Great Britain ...	2,068	3,081	+ 1,013
„ Germany	708	4,161	+ 3,453
„ France	474	24	− 450
„ U.S.A.	147	1,161	+ 1,014
Total	3,397	8,427	+ 5,030
Insulators for Telegraph or Telephone—			
From Great Britain ...	11,058	15,753	+ 4,695
„ Germany	81,909	89,772	+ 7,863
„ U.S.A.	12,099	1,611	− 10,488
„ Other countries ...	3	72	+ 69
Total	105,069	107,208	+ 2,139
Electric Ventilators—			
From Great Britain ...	—	10	+ 10
„ Germany	—	140	+ 140
„ United States ...	1,416	—	− 1,416
Total	1,416	150	− 1,266
Telegraphic Apparatus—			
From Great Britain ...	1,040	48,960	+ 47,920
„ Germany	4,560	9,440	+ 4,880
„ U.S.A.	2,880	3,280	+ 400
„ Other countries ...	400	—	− 400
Total	8,880	61,680	+ 52,800
Parts for Electric Tramways—			
From Germany	Not shown	13,132	—
„ United States ...		166,446	—
Total	—	179,578	—
Electric Hand Lamps—			
From Great Britain ...	192	—	− 192
„ Germany	1,493	514	− 979
„ France	50	32	− 18
„ Italy	—	54	+ 54
„ United States ...	30	—	− 30
Total	1,765	600	− 1,165
Telephones—			
From Great Britain ...	14,280	3,340	− 10,940
„ Germany	17,820	44,480	+ 26,660
„ Belgium	2,000	680	− 1,320
„ United States ...	19,800	21,160	+ 1,360
„ Other countries ...	560	240	− 320
Total	54,460	69,900	+ 15,440
Accessories for Telegraphs and Telephones—			
From Great Britain ...	189	34,844	+ 34,655
„ Germany	645	22,936	+ 22,291
„ United States ...	1,797	23,287	+ 21,490
„ Other countries ...	258	1,213	+ 955
Total	2,889	82,280	+ 79,391
Cranes, &c.—			
From Great Britain ...	22,571	261,832	+ 239,261
„ Germany	62,992	41,897	− 21,095
„ Belgium	—	12,789	+ 12,789
„ United States ...	3,254	1,466	− 1,788
„ Other countries ...	2,063	535	− 1,528
Total	90,880	318,519	+ 227,639
Machines, &c., for Electric Lighting—			
From Great Britain ...	106,878	228,092	+ 121,214
„ Germany	368,230	223,295	− 144,935
„ France	9,355	1,235	− 8,120
„ Belgium	715	—	− 715
„ United States ...	467,847	308,501	− 159,346
„ Other countries ...	—	2,707	+ 2,707
Total	953,025	763,830	− 189,195
Motors—			
From Great Britain ...	1,091,704	1,788,685	+ 696,981
„ Germany	115,786	214,955	+ 99,169
„ France	1,453	48,919	+ 47,466
„ Belgium	20,995	32,000	+ 11,005
„ United States ...	25,245	35,684	+ 10,439
„ Other countries ...	—	2,418	+ 2,418
Total	1,255,183	2,122,661	+ 867,478
Locomotives and Tenders—			
From Great Britain ...	167,[illegible]95	401,242	+ 234,047
„ Germany	658,989	3,087,692	+ 2,428,703
„ Belgium	—	84,472	+ 84,472
„ United States ...	[illegible]209	236,034	+ 55,825
Total	[illegible],393	3,809,440	+ 2,803,047

N.B.—Peso = 1/6

A Bradford Annual Gathering.—On December 30th and 31st the first annual meeting of branch managers, agents and representatives of Mr. Chas. Pullan, electrical engineer and contractor, was held at the offices in Bradford. Good progress was reported. On the evening of the 31st the whole party were entertained to dinner at the Talbot Hotel by Mr. Pullan.

Electrical Exhibition.—An electrical exhibition is to be held at Acton, from January 18th to the 25th.

Power Equipment Work by the B.T.-H. Co.—The following are among the important electric power installation contracts secured by the British Thomson-Houston Co., Ltd.:—At the Mold Collieries a new application of the electric motor is found in one of 500 h.p., operating at the high speed of 1,450 r.p.m., designed for 500 volts 50 cycles three-phase, to be direct connected to a turbine pump which will operate against a head of approximately 600 ft. In the same pump-house there will be erected two 275-h.p. motors direct-connected to low-speed pumps running at 180 r.p.m., all supplied by the B.T.-H. Co.

For the Moss Hall Coal Co., the company is furnishing a complete electrical equipment for the Maypole and Lowhall pits, including the provision of a new generating station equipment, which comprises two 350-kw. steam-driven generators with the necessary switchboard, the whole of the cable work for the same, and a small lighting set of 40-kw. capacity. The equipment of the Maypole pits includes four sets of electrically-driven pumps, complete with the necessary switchgear, and the whole of the cable work, both on the surface and underground, together with all the overhead transmission line. The primary voltage is 3,000 volts, and the current three-phase 50 cycles. The equipment of the

Lowhall pit, which will be operated from the same generating station, includes three sets of pumps of the horizontal three-throw type of large capacity, to which will be coupled three 135-H.P. motors, and three sets of haulage gear, together with the complete cable equipment, both surface and underground. The equipment of this colliery is particularly complete, and is claimed to be one of the largest contracts placed during the past year for the equipment of a colliery.

From Messrs. Dorman, Long & Co., Ltd., of Middlesbrough, during the year the B.T.-H. Co. received a contract for the electrical equipment of a reversible cogging mill. This is claimed to be the first electrical equipment of this nature that has been placed with a British firm. It involves the supply of very heavy electrical machinery, including the main mill motor, which has a continuous capacity of 1,200 H.P., and a maximum torque capacity up to 3,600 H.P. developing these powers at a speed of 70 R.P.M. This complete equipment marks an important step in the application of electrical power in this country to the operation of the heavy machinery in steel works. The smaller machines have been operated electrically for many years past, but it has always been considered, up to recent times, that anything of the nature of a heavy rolling mill could best be operated by steam. It is interesting to note that this development indicates, what has been consistently advocated by electrical engineers for many years past, that there is no practical limit to the application of electric power to any duty, the only condition to be considered is the commercial efficiency of the application in each case. It is of interest to note that electrically-operated rolling mills are expected by many steel works experts to show an increased production in a given time over the older methods, the mill itself being so directly under the control of the operator.

Another important development in the application of electrical power for industrial purposes is, of course, the advance that has been made in connection with the electrical operation of textile mills, and in this connection the British Thomson-Houston Co. have now installed upwards of 10,000 H.P. in motors in textile mills in the United Kingdom, and are at present engaged in the electrical equipment of a large mill in the Manchester district which involves the installation of upwards of 75 motors varying in capacity from 7½ H.P. to 170 H.P. each.

Calendars and Catalogues.—MESSRS. A. HART & CO., electrical engineers, Newhaven Road, Bonnington, Edinburgh, have sent us one of the nicest wall calendars yet received. Words fail us to describe the charms of *the* feature, but we have quite fallen in love with it.

From the WESTERN ELECTRIC Co., of Norfolk House, Victoria Embankment, W.C., we have received a serviceable wall calendar, also an abridged price list of Association wires and cables, flexible cord, &c.

The ELECTRIC AND GENERAL STORES, of Bridge Street, Sunderland, and Leeds, have sent us a wall calendar with small, but plainly printed, monthly slips, above which is a reproduction in colours of the late E. J. Niemann's "Nature's Realm."

The BRITISH GRIFFIN CHILLED IRON AND STEEL Co., LTD., of 139, Cannon Street, E.C., and Barrow-in-Furness, are sending out to their friends a useful calendar, with monthly slips and daily date cards. Steel-tired, chilled-iron wheels, and other of the firm's manufactures are shown.

We learn from MESSRS. MARPLES, LEACH & Co., that they have been so overwhelmed with inquiries for the little 6-in. slide-rule memento since the publication of a notice thereof in our pages, that the manufacturers have completely run out of stock. Any applicants who have not yet received their rules, are asked to note that the firm are doing their utmost to keep their promise, and that they hope to forward them during the next 10 to 14 days.

MR. WILLIAM SANDERS, Falcon Electrical Works, Wednesbury.—A number of lists have come to hand showing the firm's telephone message oscillating recorder, "Pope" electric lamps, "Rip" gas and damp-proof fittings, wood blocks, fuses, fuseboards, service boxes, ironclad knife, "Defiance" and other switches, and so on.

MESSRS. POOLEY & AUSTIN, 25, Victoria Street, S.W.—Copy of pamphlet just issued relating to "Osram" lamps, stating their chief features and price.

MESSRS. MOUNTAIN & GIBSON, LTD., of Bury, have circulated to many of their friends a substantial and serviceable note-book and diary. A good sized page (ruled) is available for each day, and this will be convenient to many engineers and tramway men for note-taking—perhaps for jotting down practical notes to be afterworked up into interesting articles or letters in the ELECTRICAL REVIEW.

A card received from the B.T.-H. Co., of Rugby, gives one a small picture, "Sunset in the Fens," beneath it being depicted a B.T.-H.-Edison lamp, to be used when the sun sets. On the back of the card is a list of places where these lamps may be bought in London. A new 12-page booklet has also come to hand, showing some of the company's electric cooking and heating outfits.

To MESSRS. THERMIT, LTD., 27, St. Martin's Lane, Cannon Street, E.C., we are indebted for a useful pocket note-book. Opening pages contain general and interesting illustrated matter concerning "Thermit" process and applications, and calendar information follows. The bulk of the book is in the form of a note-book—not a diary.

The CONSOLIDATED ACCESSORIES Co., of 27, Clement's Lane, London, E.C., have sent out to tramway managers and others a card showing statistically the increasing popularity of the "Peacock" brake, of which 1,159 car sets have been supplied in the United Kingdom since its introduction three years ago—674 being during 1907. We are asked to draw attention to a slight slip that has got on to the card. The letters "Ltd." ought not to appear at the end of the company's name, which is correctly rendered above.

The REASON MANUFACTURING Co., LTD., of Lewes Road, Brighton, have sent us a useful desk blotter, which we shall never use without being reminded by a big, but unobjectionable, name-plate of Reason lamps, time switches, demand indicators, and so on.

MESSRS. MATHER BROS., electric lighting engineers, 36, Farringdon Street, E.C.—Wall calendar with monthly sheets and clear figuring.

MESSRS. C. J. EDWARDS & SON, LTD., of 32-34, Great Sutton Street, Clerkenwell, E.C., have sent us a large wall sheet calendar giving a list of shafting, beltings, oils, engineers' stores, and other lines stocked by them.

MESSRS. CROMPTON & Co., LTD., Salisbury House, London Wall, E.C.—Publication (P. 28) containing an illustrated description with prices, &c., of the Crompton-Blondel system of flame arc lighting.

The EMPIRE ROLLER-BEARINGS Co., LTD., 15, Victoria Street, London, S.W.—New revised catalogue (24 pp.) in which is given full information concerning these roller bearings for tramway axles and line shafting, also many testimonials from users.

The ELECTRICAL FITTINGS Co., LTD., 38, Conduit Street, London, W.—Catalogue (8 pp.) in which are illustrated and priced the company's new patent adjustable desk standards of which we have already published a description; also a leaflet showing their "Leopold" luminous electric radiators.

The CRUSE CONTROLLABLE SUPERHEATER Co., Manchester.—Pamphlet describing their patent controllable and tubular heat accumulator superheaters. Two large sheets of detailed drawings are folded in showing a sectional type controllable superheater of 32 pipes size, and a heat accumulator superheater of 16 loop size.

We have received a very artistic calendar from MESSRS. MAWDSLEY'S, LTD., of Zone Works, Dursley, Gloucester, makers of the "Zone" dynamos and motors. According to a circular letter which Messrs. Mawdsley's are sending with the calendar, the picture is a colour reproduction of the well-known painting "Genevieve," by Henri Rondel, and so as to make this as acceptable as possible, they have abstained from printing advertising matter on the calendar.

The LONDON DECORATIVE METAL WORKS, LTD., 44-46, Eagle Street, Southampton Row, W.C.—New list of ornamental switch plates, door furniture, &c., of the former of which the firm claims to have a greater variety than any other firm in this country. A large number of new and original designs is submitted, in the Adam, Renaissance, Classic, Empire, and many other styles, with various finishes; judging by the beautiful half-tone illustrations, these designs are of high artistic merit and refined taste.

Gas Engine Indicators.—The CROSBY STEAM GAGE AND VALVE Co., of 147, Queen Victoria Street, London, E.C., have just issued a small 20-page booklet dealing with the indicating of gas and oil engines. They have published this in the belief that with the increase in the size of internal combustion engines, and the higher pressures used, there is room for information as to the use of the gas engine indicator. The hints contained in the pamphlet are based on experience obtained over a number of years, and an endeavour is made to explain not only how to fit up and use the indicator, but to suggest how some of the various causes which tend to produce errors in the diagrams may be eliminated. Copies can be obtained by those interested in the subject.

Time-Recorder Developments.—Some ten years ago the Bundy time-recorder was introduced, and four years later the Rochester card-recorder was brought on to the market to meet the want of manufacturers for a machine which not only mechanically checked the times of arrival and departure to and from work, but which would also provide a system of costing mechanically controlled. The INTERNATIONAL TIME-RECORDING Co., of City Road, E.C., have since been engaged simplifying the system, so that the least mental effort would be required by the time and cost clerk in making out the times at the end of the week. This, we understand, has been solved in the two-colour printing recorder, by which the regular times are printed in *blue*, and the late and overtimes are printed in *red*. All this is done automatically, and is an obvious advance.

Dissolutions and Liquidations.—ELECTRIC POWER DEVELOPMENT Co., LTD.—This company is winding up voluntarily, with Mr. G. R. Bostock, 21, Ironmonger Lane, E.C., as liquidator.

PHODYNE ELECTRICAL Co., LTD.—A meeting is to be held at 66, Victoria Street, S.W., on February 4th, to hear an account of the winding up from the liquidator, Mr. A. W. Langley.

ELECTRIC POWER DEVELOPMENT Co., LTD.—Creditors must send particulars of their debts, &c., to Mr. G. R. Bostock, 21, Ironmonger Lane, E.C., the liquidator, by February 29th.

ELECTRICAL IMPROVEMENTS, LTD.—A meeting is to be held at 44, Parliament Street, Nottingham, on February 17th, to hear an account of the winding up from the liquidator, Mr. J. Robinson.

JOHNSTONE, BENJAMIN & Co., LTD.—The first meeting of creditors is to be held on January 17th at 11.30 a.m., and that of contributories at 12 o'clock on the same day, both at 33, Carey Street, W.C.

Book Notices.—*Wireless Telegraphy for Amateurs.* By R. P. Howgrave-Graham. London: Percival Marshall & Co. Price 2s. net.—This unpretentious little book should supply a long-felt want for a cheap and reliable introduction to the theory and practice of wireless telegraphy. There are numerous other small introductory works on the market, but few, if any, touch the practical side of the question, so dear to the amateur, with so solid and reliable a grasp. The author has taken his stand by the Lodge-Muirhead system, and the greater portion of the book is solely concerned with this system, with which he has evidently been in practical touch. Passing over the introductory parts, in which the author expresses opinions relative to the history and development which are open to some controversy, a description with details of construction of a short-distance installation and its capabilities are dealt with, followed by very practical and workmanlike suggestions in the way of the construction of simple but effective apparatus. The book should command a ready sale, and is well suited to the amateur who wishes to get really good advice on the construction of inexpensive and useful apparatus for investigations on a small, though not too limited, scale.

Fowler's Mechanical Engineer's Pocket-Book, 1908. Manchester: Scientific Publishing Co. Price 1s. 6d. net.—This, the tenth, annual edition has been thoroughly revised, and in some parts enlarged; new sections have been substituted for certain old ones, and the book is, on the whole, increased by over 100 pages. Blank pages for memoranda are conveniently inserted at the end of each section. The book contains an abundance of useful information, covering a very wide range.

"*Mechanical World*" *Electrical Pocket-Book for* 1908." Manchester: Emmott & Co. Price 6d. net.—This is a newcomer in the pocket-book world, forming a companion to its well-known predecessor from the same office. It is intended especially for the use of those in charge of, using, or applying electrical plant, and the mechanical side of the subject has therefore received special attention, while such matters as telegraphy, telephony and electric traction are not dealt with. The present issue comprises about 138 pages, and the text consists of brief articles on units, electrolysis, dynamos and motors, alternating currents, care and management of machines, lines and wiring, instruments, accumulators, lighting, welding, cranes and pumping, followed by notes on engines and gearing, with a number of tables and a diary. Altogether it is a neat and useful production, and doubtless it will grow in size and value yearly.

Its elder brother, the "*Mechanical World*" *Pocket Diary and Year Book* for 1908 has also been issued, and needs no commendation, though we may note that the electrical section has been omitted, and new sections on condensing plant, superheating, friction clutches, &c., have been substituted.

"*Proceedings* of the Engineering Association of New South Wales." 1900-2 and 1906-7. Edited by H. V. Ahrbrecker. Sydney: The Association.

"Science Abstracts." Vol. 10. Part 12. No. 120. Sections A and B. London: E. & F. N. Spon, Ltd. 1907. Price 1s. 6d. per section.

The "Max" Motor-Cycle.—From the Motor Van Department of Messrs. Johnson & Phillips we have received an illustrated leaflet describing a motor-cycle which they recently placed on the market. It is claimed to be specially suitable for inspection work where a number of stoppages are necessary in a short distance, and for speeds of from 2 to 15 miles per hour. The weight is very low, which adds to the general economy of the machine in the way of tire upkeep, petrol consumption, &c., and owing to the special design, which is fitted with footplates and a collapsible seat if required, the space necessary for storing is very small. We understand that the machines attracted a good deal of attention at the recent Stanley Cycle Show.

The Royal Arms.—Lists, corrected and revised up to January 1st, 1908, have been issued from Buckingham Palace, giving the names of the "tradesmen" holding warrants of appointment, and who are authorised to use the Royal Arms. The following names are in the lists:—Edison and Swan United Electric Co., Ltd., London, electric lamps; Electrical Power Storage Co., Ltd., London, electrical secondary cells; A. P. Lundberg & Sons, London, electrical accessories; City and Suburban Electric Carriage Co., London, electric carriages; Hassel & Fendt, Copenhagen (warrant from the Lord Chamberlain to the Queen), purveyors of electric light. It is notified that Tasker, Sons & Co., Sheffield, telephone and electric lighting engineers, are authorised to style themselves, "By appointment to the late Queen Victoria," and to use the Royal Arms.

Trade Announcements.—The Phœnix Dynamo Manufacturing Co., Ltd., of Thornbury Works, Bradford, notify the following additions to their staff:—Dr. Pohl, who originally was with them as designer in direct and alternating-current machinery, and who until recently was devoting a large portion of his time to the Electrical Department of the Bradford Technical College, is now, owing to pressure of work at the Phœnix Co., devoting the whole of his time to the P.D.M. as chief designer. They have recently made a change at their London office, and Mr. A. P. Whitehead, formerly with the Lancashire Dynamo and Motor Co., is now the Phœnix Dynamo Manufacturing Co.'s manager at 17, Victoria Street, Westminster. Mr. T. W. Ellis has been appointed the Phœnix Dynamo Manufacturing Co.'s representative and district manager for South Wales with address at Charnwood House, St. George Street, Swansea. Mr. H. C. Noble has been appointed district manager on the North-East coast having charge of that district and the east of Scotland up to Edinburgh, with offices at 42, Pilgrim Street, Newcastle-on-Tyne. Mr. R. V. C. Brook has been appointed Birmingham district manager with headquarters at Birmingham.

The Gandy Belt Manufacturing Co., Ltd., 97, Queen Victoria Street, E.C., announce that they have installed a second telephone: number Bank 832.

Mr. J. C. Brown, M.I.M.E., for many years connected with the firm of Roland Carr & Co., has been appointed manager for the London division for Mr. W. H. Keys, of West Bromwich, and in that capacity he will be again in touch with former electrical friends for the supply of bitumen, compounds, &c.

LIGHTING and POWER NOTES.

Bangor.—An inquiry on behalf of the L.G.B. was held on January 2nd by Mr. H. A. Reed, relative to an application by the Corporation to borrow £1,000 for the purposes of electric lighting.

Bedford.—The T.C. on January 1st decided to extend the E.L. mains to the London Road Estate, both for private and public lighting.

Burgess Hill (Sussex).—The B. of T. has requested the Electric Supply Co. to comply with the regulations under Sec. 4 of the E.L. Act, 1888, with regard to the height of wires, &c.

Bury (Lancs.).—The T.C. has sanctioned the scheme of the General Purposes Committee for establishing generating plant for the purpose of supplying energy on the alternating system to manufacturers, and also to increase the present supply. The estimated capital expenditure is £70,000.

Clyde Valley.—The Clyde Valley Electric Power Co. reports a steady improvement in its load during the past year. According to a statement in a Glasgow paper the power available at present at Yoker generating station is 4,000 kw., and at Motherwell station 4,000 kw., and owing to the great development, the company has decided on increasing the Motherwell installation by 5,000 kw., and rearranging the Yoker installation to give an increased output of 1,600 kw. The areas covered by the company's orders have been greatly developed within the past 12 months, new cables having been laid in Bellshill, Mossend, Scotstoun, Shettleston, Rutherglen and Carfin districts, and supplies given to numerous works in the area. We may mention among those which have been connected to the mains this year:—Coventry Ordnance Works, Bull's Metal and Melloid Co., Clydebank Co-operative Bakery, Blawarthill Hospital, Halleys Industrial Motors, Yarrow & Co., Lobnitz & Co., John Jackson Co., Victoria Cover Works, Mechan & Sons, Clyde Trust Workshops, United Collieries, Smith & M'Lean, Rivet, Bolt and Nut Co., Glasgow Iron and Steel Co., Anderson, Boyes & Co., John Watson, Dunn & Stephen, James Eadie & Sons, Shanks & M'Ewan, Stewarts & Lloyds, Farme Coal Co., Archibald Russell, Acme Steel and Foundry Co., Motherwell Iron and Steel Co., A. Anderson & Sons, Rolled Steel Forge Co., John Williams & Co., R. Addie and Sons, Orr, Watt & Co. The company is also engaged in the construction of an overhead line from Tannochside Colliery to Garteosh, Glenboig, Coatbridge, and back to Douglas Support, which will be one of the longest overhead lines in the country. This line is primarily intended to serve as a loop main for a supply to the Glenboig Union Fireclay Co., Ltd., Glenboig and Gartosh Works, who will shortly have 1,000 h.p. in motors off this company's supply, and for the Gartosh Iron and Steel Works of Messrs. Smith & M'Lean, Ltd. The company's circuits are also across the Clyde at Renfrew Ferry, and the new engineering works and slip dock of the Clyde Navigation have a complete and comprehensive installation from the company's mains, including a 200-h.p. motor for the slip dock. Rolling mills offer a large field for the introduction of electric power. The Clyde Valley Co. has concluded contracts with various works for six mills, among which may be mentioned Motherwell Iron and Steel Works, John Williams and Co., Smith & M'Lean, Pather Iron and Steel Works, and Etna Iron and Steel Works. The company has at present 12 collieries taking supply from its mains in the Lanarkshire district. The total length of the company's main and distributor cables exceeds 140 miles.

Cobham.—The question of the introduction of electric lighting is agitating the village, the proposal before the Parish Council being the extension of the mains of the Woking Electric Supply Co., Ltd., for public and private lighting. There is at present no street lighting of any kind, the price of the local gas, 5s. per 1,000 cb. ft., being considered prohibitive, and, moreover, very little gas is used in the village, which has a population of 4,000. A large number of new and substantial residences have been erected during the past few years, and all of these are occupied. The attitude of certain "rural aspectors" has hitherto stood in the way of the adoption of the Lighting Act.

Colchester.—The town clerk has sent a circular letter to the municipalities affected, calling attention to certain provisions, in reference to the supply of electrical energy, sought to be

obtained by the G.E.R. Co. under the General Powers Bill it is promoting for the ensuing Session of Parliament. The Electricity Supply Committee is of opinion that the interests of authorities possessing powers of electrical supply may be seriously affected by the proposed measure, and the various Town Councils are urged to oppose the Bill.

Dublin.—The Lighting Committee has just issued a report for the year ending March 31st, 1907, from which it seems that the gross amount received was £44,225, of which £10,736 was credited to public lighting and the balance to private consumers. The gross profits were returned as £22,196 11s. 6d. In the plan for the extended works, a sale of 1,529,000 units was anticipated, and that was exceeded by 700,000 units, so rapid was the increase chiefly amongst private consumers.

Farnworth.—In order to meet the growing demand for energy from the local consumers, the U.D.C. is considering the advisability of enlarging its works or obtaining a bulk supply from the Lancashire Electric Power Co.

Halesowen.—Negotiations are proceeding for the transfer of the E.L. order to the Light Railways Co., which is taking over the Council's Light Railways order on January 20th.

Houghton-le-Spring.—The U.D.C. has asked the Electric Supply Co. to submit an estimate of the cost of lighting the town by electricity.

London.—HACKNEY.—The E.L. Committee of the B.C. has submitted a report favouring the establishment of a special sales department to develop the undertaking; also the provision of consumers' installations on a cash or hire-purchase system. It is suggested that a showroom for fittings, &c., be equipped in a central situation, and that a sales engineer be appointed at £120 per annum.

WOOLWICH.—On the advice of the acting engineer, the B.C. has agreed that heating or power consumers, with a load factor exceeding 15 per cent., shall be supplied at 1d. per unit, and that time switches may be dispensed with, providing the consumer agrees to restrict his peak load to a minimum; also that such a consumer may use up to 7 per cent. of his energy for lighting. Consumers under the same load factor conditions are to be allowed energy at 1d. per unit for electric signs.

Newport (Mon.).—The L.G.B. has sanctioned a portion of the loan of £30,000 applied for by the T.C. about 15 months ago, for electricity purposes. Between £4,000 and £5,000 has been withheld, for further information to be supplied to the L.G.B.

Oulton Broad.—The U.D.C. has decided not to consent to the application of the Lowestoft T.C. for a prov. order for E.L. for the district, as the Council is applying for its own order.

Romford.—The R.D.C. has decided to take a neutral position with regard to the Bill of the London and District Electricity Supply Co.

South Africa.—CAPE TOWN.—A feature of the gala season, which was recently inaugurated, is the electric illumination of the historic Government Avenue. The work, which was carried out by the Corporation electric light department, comprises festoons of thousands of coloured lamps most tastefully arranged amongst the oak trees and outlining the fences of the paddocks. The Woodstock Beach has also been temporarily illuminated by the Corporation with arc lamps for the occasion.

Sowerby Bridge.—The U.D.C. has applied to the B. of T. for an amended order authorising the transfer of the E.L. order, 1900, to the Electrical Distribution of Yorkshire, Ltd., or to any other company the B. of T. may approve.

Stevenage.—The E.L. Supply Co. has informed the U.D.C. that it is impossible to proceed with the E.L. scheme for some time, but it intends to commence the work at the first opportunity; it added that "if the Council had anyone else in view to take the matter up, it would do its best to facilitate such a movement." The Council has directed the clerk to seek legal advice as to the best way to proceed against the company.

Stroud (Glos.).—The B. of T. has asked the U.D.C. when it proposes to discharge its obligations under the E.L. order. The Council, on January 1st, referred the matter to the Streets and Lighting Committee.

Sunderland.—The new Willans-Dick, Kerr turbo-generator, which the Sunderland Corporation has just had erected at the Hylton Road works, was formally started on the 6th inst. by Alderman Bruce, Chairman of the Electricity and Lighting Committee. The scheme under which the extension has been made was passed on January 9th, 1907, and the estimated cost was £41,600. The order for the turbo-generator was placed on March 13th, 1907, the contract price being £10,531. The machine is of the three-phase A.C. type generating at 5,000-5,500 volts pressure, designed for a continuous load of 2,000 KW. at 1,500 R.P.M. Four Babcock and Wilcox boilers with superheaters, chain-grate stokers, water treating plant, boiler feed pumps, coal bunkers and coal conveying plant, &c., have also been installed, the contract price being £15,708.

Wrexham.—The Triplex Co., electrical engineers, of Wrexham, have written to the T.C. complaining that the Corporation competes for electric installation work, and in addition trades largely in E.L. supplies. The matter has been referred to the Electricity Supply Committee for consideration.

York.—With regard to the proposal of the Electricity Committee to establish a showroom for the sale of electrical fittings, &c., four local firms of electrical contractors have sent a letter asking the Council to reconsider its decision, and protesting against the opening of a showroom until they have had an opportunity of placing their views as private traders before the L.G.B. at the forthcoming inquiry.

TRAMWAY and RAILWAY NOTES.

Beeston.—The U.D.C. has decided to support the application of the Notts and Derbyshire Power Co. for an extension of time for commencing the construction of tramways in the district.

Belfast.—At the weekly meeting of the Tramways and Electrical Committee on the 6th inst., the city surveyor, Mr. Cutler, submitted a voluminous report dealing with the alleged inaccuracies brought forward by the Citizens' Association in connection with the conversion of the tramway system, and the alleged overpayment of sums of £661 11s., £5,670, £277 7s. 4d., £2,218 10s., £1,417 13s. 3d., £7,390, £5,518, £2,931 and £12,000 in connection with various parts of the work. The Committee decided to postpone the consideration of the matter for a fortnight. It may be recalled that the Corporation expressed itself as confident in Mr. Cutler's figures, when the matter was brought before it.

Birmingham.—In a report to the B. of T. on the fatal accident which occurred on October 1st, Colonel H. A. Yorke attributes the accident to the action of the inspector in taking the car down Warstone Lane with a defective magnetic track brake, and experimenting with that brake on the incline, and adds that had the hand brake been applied before starting down the incline no accident would have occurred, as the gradients are such that the car might well have been controlled by means of the hand brake, the only precaution necessary being that the hand brake should be applied at the commencement of the hill, so that the speed of the car should be checked from the outset.

Blackburn.—The T.C. has decided to oppose the revival of the Blackburn, Whalley and Padiham Light Railways Order.

Bolton.—A special meeting of the T.C. was held on Monday, to consider the question of promoting a Bill in the next session of Parliament for the construction of a tramway line in Hulton Lane. The scheme originated in connection with the borough extension some years ago, wherein an arrangement was made with the late Sir Wm. Hulton, Bart., a large landowner in the district. A vote being taken, the Council decided in favour of the promotion of the Bill by 54 votes, there being 10 neutrals. The proposed tramway is in one of the suburbs of the town which has developed of late years.

Continental Notes.—GERMANY.—The first "railless tramway" was constructed and opened in the Biela Valley (Bielathal), Saxony, in July, 1901. It was in operation as an experimental line for about three years, when, owing to the insufficient goods traffic, it was removed to Wurzen, Saxony. Other lines are now in operation at Grevenbrück, Westphalia (length 1½ kilometres); Veischedethal, Westphalia (Grevenbrück-Bilstein-Kirchveischede, 9 kilometres in length); and Monheim-on-Rhine (length 4½ kilometres).—*Board of Trade Journal.*

The light railway between Bruhl and Cologne is to be converted into an electric line.

SPAIN.—The Barcelona Tramways Co. has applied to the Spanish Government for a concession to construct and work two new lines of electric tramways in the town of Barcelona.

Douglas.—The Tramways Committee on Monday decided to recommend to the Council to issue tickets on the tramways at half the usual price to workmen earning £1 and under a week.

Dudley.—At last the Corporation agreement to purchase from the B.E.T. Co. the whole of the tramlines within the borough, is on the eve of completion. The agreement was drafted in 1897, and was to have come into force in 1904. The Corporation are to purchase the lines for £71,000, and to lease them at a rental not yet fixed, to the company. At the next meeting of the T.C. the seal of the Corporation is to be affixed to the agreement.

Glasgow.—A serious runaway accident occurred on January 3rd, when 9 people were injured, two fatally. The accident occurred during busy hours and in a fog; the car, having a full inside complement of passengers, apparently got out of control on a hill, colliding with a cart, which had the effect of throwing off the motorman and a lad. Practically uncontrolled, the car ran down the hill colliding with carts and pedestrians *ad lib*, and missing other cars only by inches, finally stopping on the level. Nearly all the injured were pedestrians.

Halesowen.—At the meeting of the U.D.C. last week, it was announced that satisfactory progress is being made in respect to the transfer of the Light Railways Order to the Halesowen Light Railways Co. Providing no objection is made, the B. of T. will, it was stated, sanction the transfer on January 20th

on terms which are satisfactory to the Council, the promoters, and the County Council. The promoters will pay the costs the Council has been put to within 14 days after the signing of the transfer; £525 will be paid 60 days afterwards; and a similar sum at the expiration of six months and 60 days. This means that in the near future Halesowen will be provided with electric tramways, which are greatly needed.

Hazel Grove—Macclesfield.—The Macclesfield and District Tramways Co. has abandoned the scheme for extending the electric tramways from Hazel Grove to Macclesfield.

Japan.—The Austro-Hungarian Consul at Yokohama in a recent report states that in the year 1906 there were in Japan 16 electric tramway companies, with a working capital of 46,000,000 yen (against 38,000,000 yen in 1905). The length of line open to traffic amounted to 173 miles (an increase of 26 miles, as compared with 1905), and there were under construction 99½ miles. The number of passengers carried had greatly increased, and amounted in all to about 161,161,404. The receipts amounted to 6,337,278 yen, and the expenditure to 3,787,604 yen, leaving a net income of 2 549,674 yen. The dividends declared by the companies varied greatly, but averaged 8·52 per cent. The largest dividend, 38 per cent., was paid by the Kyoto Co.; the Tokio-Yokohama (Keihin) Electric Tramway Co. declared a dividend of 13 per cent. The most important of the Japanese electric tramway companies is the Tokio Railway Co. with a working capital of 27,000,000 yen, and a length of line of 45·6 miles; this company alone carried 136,000,000 passengers during 1906. The net profits amounted to 1,834,523 yen, and a dividend of 5·81 per cent. was declared. The next most important is the Kioto Osaka Co. with a capital of 7,000,000 yen, which is now building its line to a length of 30·6 miles. There may also be mentioned the Osaka Kobe Electric Tramway Co. with a capital of 3,000,000 yen, and 19 miles of line, and the Tokio-Yokohama Electric Tramway Co., capital, 2,550,000 yen, length of line 17 miles.

London.—Paddington.—At the meeting of the B.C. on Tuesday, the Works Committee reported as to negotiations which had taken place between it, the L.C.C. and the Metropolitan Electric Tramways, Ltd., regarding the decision of the County Council to purchase the Harrow Road tramways. The company called attention to the inconvenience which would be caused to residents in Paddington if the service of cars between Willesden and Lock Bridge had to be stopped at the county boundary. Representatives of the B.C. waited upon the Improvements Committee of the L.C.C. and informed it that if the Harrow Road tramways were extended through Paddington, the local authority would not bear any portion of the expense of street widenings. The Works Committee recommended that subject to the Metropolitan Electric Tramways, Ltd., entering into an agreement with the Council with regard to the widenings in Harrow Road, no opposition be offered by the Council to the company's Bill; and that representations be made to the B. of T. with regard to the inconvenience which would arise in the event of there being dual control of the tramway lines within the borough. The matter, was, however, left over for consideration at a later date.

Islington.—The L.C.C. has notified the B.C. of its intention to proceed at an early date with the reconstruction on the conduit system of the tramways from King's Cross *via* Caledonian Road, Holloway Road, &c., to Finsbury Park.

Hammersmith.—The Law and Parliamentary Committee of the B.C. has decided on opposing the Bill of the West London, Barnes, and Richmond Tramway Co. in the coming Parliamentary Session.

Manchester.—The B. of T. has consented to the laying of a double line of tramway in lieu of the single line in Manchester Road and Barlow Moor Road, Chorlton-cum-Hardy.

The proposed tramway line in Wood Street and Derby Street, Openshaw, in which the engineering firm of Armstrong, Whitworth and Co. are specially interested, has been the subject of further negotiation between the firm and the Tramways Committee, the point being as to the type of rail to be adopted. The line will connect the engineering works with the tramway system of the city. A conference recently took place between representatives of the Committee and Messrs. Armstrong, Whitworth & Co., when the former submitted a drawing of a rail section (which the B. of T. had already sanctioned for an existing tramway), with a groove 1½ in. wide. This, with a slight modification, was agreed to, subject to a clause in the agreement with Messrs. Armstrong, Whitworth and Co., placing upon them all responsibility in connection with the laying and user of the tramway, and fully indemnifying the Corporation, and also subject to the approval of the B. of T.

There is a probability of work on the Northenden Road line, in Sale, being shortly begun by the Manchester Corporation. A lease of the line from the Sale Urban Council has been arranged. The work will involve the widening of the bridge over the South Junction Railway.

Negotiations are proceeding for the lease by the Corporation of the existing tramway lines in the Urban District of Levenshulme.

The Corporation, as contractors for the Audenshaw Urban Council, will shortly proceed with the construction of the intended tramway line in Audenshaw Road.

Newark-on-Trent.—The promoters of the light railways for the district have applied to the B. of T. for an extension of two years for commencing the construction of the railway.

Oxford.—The question of adopting the Dolter surface-contact system has once again come before the Corporation. Under Section 52 of the Oxford and District Tramways Act, 1907, the Corporation has power to substitute some other system of traction (but not the overhead trolley system), in the event of the Dolter system not having worked satisfactorily for six months by January 1st, 1908. On December 16th the members of the Corporation, with Mr. Stephen Sellon, their consulting engineer, visited Hastings to inspect the short length of Dolter track working there. Mr. Sellon, in accordance with instructions, has given his views on the working of the system, pointing out that the experimental stage has not yet been passed: that the stud difficulty and excessive energy consumption, even under the ideal conditions existing at Hastings, still remain. He points out that no reliable return of working expenses has been published by the Dolter Co., and that the latter cannot possibly commence any construction for at least six months. He recommends that full advantage be taken of the protective clause, which places the responsibility of choice of system on an arbitrator in case of difference between the Corporation and the company. After full and deliberate consideration, the General Purposes Committee has recommended that the following resolution be adopted by the Council:—"That, in the opinion of the Corporation, the Dolter surface-contact system has not been working satisfactorily for six months in any place in Great Britain." It may be noted that the Hastings Tramway Co. is by agreement bound to take over its Dolter section on January 12th, if it complies with the Dolter Co.'s guarantee, and this matter will be watched with interest by the Oxford authorities.

Wallasey.—It is understood that the U.D.C. will shortly apply for Parliamentary powers to extend the tramway system. A year ago the House of Lords rejected the application for powers to extend, on the ground of undue competition with the Wirrall T.C.

Wolverhampton.—It now appears that not only snow, but frost as well, has to be taken into account where the Lorain system of traction is concerned. At any rate, the severe frost was the means of dislocating the service on Monday morning. Asked by a representative of one of the local papers to explain the cause of the dislocation, Mr. Luntley, the manager, frankly admitted that it was "due to an extraordinary weather incident. It began to rain," he continued, "about 2.30 on Monday morning and the rain seemed to—in fact, did—freeze as fast as it fell. The consequence was that the whole of the streets, from channel to channel, were a sheet of ice. We," he added. "immediately put out cars, which were running all night." "Then," said the pressman, "this gave you as much trouble as a fall of snow." "For a time it was really worse," Mr. Luntley replied. "We were able to cut it up gradually with the ordinary cars, and then a thaw set in, and this helped us very considerably." In the morning, when people were flocking to business, four cars were "dead" at the foot of Tettenhall Rock, there being insufficient power to take them up the steep incline; and on other sections there was much delay, so that the receipts must have been for a time very much below the average.

TELEGRAPH and TELEPHONE NOTES.

Burma.—Numerous complaints have been made regarding the miscarriage and mutilation of telegrams for Europe, which it is said take place mainly on the Indian lines.

The operators of the Rangoon Telegraph Department are dissatisfied with their conditions of service, and are appealing to the Viceroy to receive a deputation.

German Telephone Rates.—The Secretary of State for the Imperial Post Office proposes to make an alteration in the charges for subscription to the telephone service, and invitations have been issued for a conference of commercial and other interested circles to discuss the question with the Minister. According to the scheme, the fixed subscription is to be abolished, and to be replaced by a basis charge for the service, and a fixed message rate. The basis charge in networks of from 1 to 1,000 connections will be £2 10s.; in networks of from 1,001 to 5,000 connections, £3 5s.; 5,001 to 20,000, £4; 20,001 to 70,000, £4 10s.; and in networks of over 70,000 the charge will be 10s. extra for each further 50,000 connections. The message rate amounts to 6d. for each connection for which a connection is established. If, however, more than 2,000 calls are completed by one subscriber in any financial year, the message rate will be reduced by ·06d. per call for between 2,001 and 6,000 calls, and further calls will be subject to an additional reduction of ·125d. per call. A rate of up to 1·2d. may be charged by subscribers for the use by a third party of the telephone in local traffic. It is proposed to charge for distant communication a rate of 2½d. for 15½ miles, 3d. for 31 miles, 6d. for 62 miles, 9d. for 155 miles, 1s. for 310 miles, 1s. 6d. for 465 miles, 2s. for 620 miles, and 6d. for each 155 miles in excess of 620 miles.

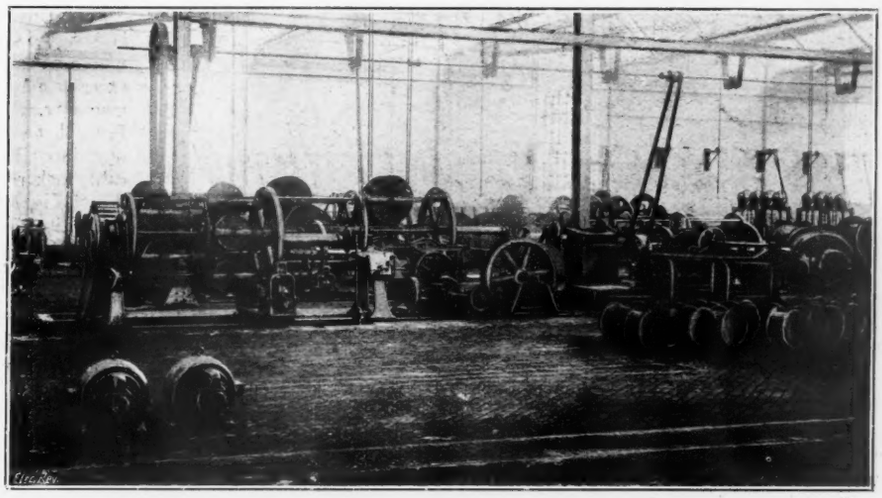
South-West Africa.—A telegraph station has lately been established at Romansdrift, 45 miles from Warmbad, German South-West Africa.

(*Continued on page 63.*)

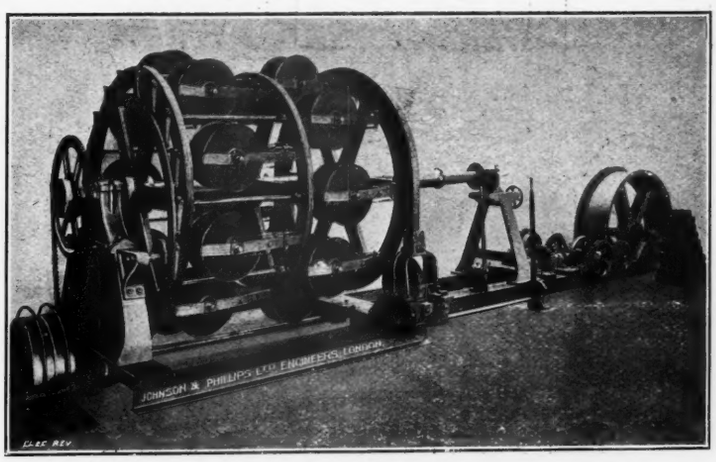
SOME NOTES ON MODERN CABLE-MAKING.

On the formation into a limited company, some few years back, of the business of the firm of Johnson & Phillips, it was very naturally found, as a result of the gradual building up of the concern out of profits extending over a period of some 30 years, that there were departments which were unduly overcrowded as well as inconveniently subdivided. This was the more noticeable in the department devoted to the manufacture of cable-making machinery containing many heavy machine tools, and the new board of directors very promptly decided to utilise their additional capital in modernising the works.

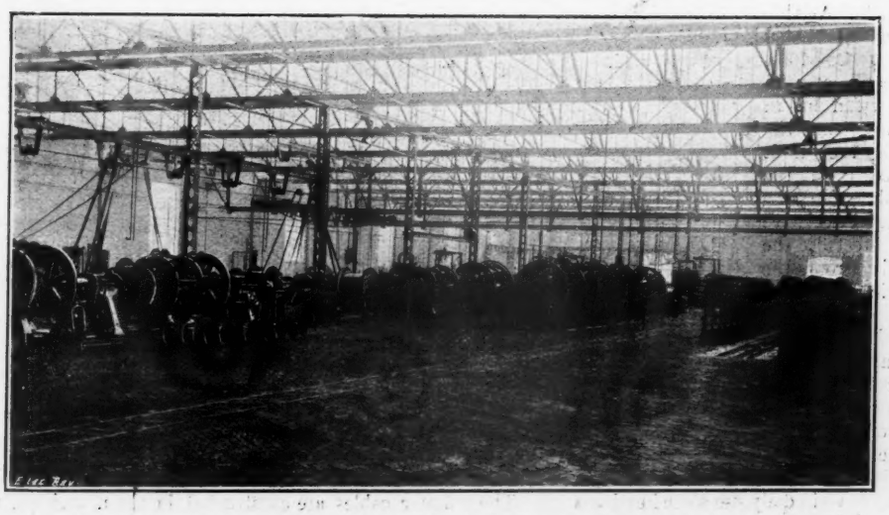
In the early stages of the company the directors decided upon the erection of a principal machine shop; this new shop has been equipped with a large amount of new plant, and, in addition, the be t of the machines in the outlying departments have been placed in it. Ample facilities for lifting work are provided in the shape of overhead travelling cranes, electrically driven. The shop is well lighted naturally and by means of arc lamps of the firm's own manufacture, whilst heating apparatus has also been installed. This work had not, however, proceeded far when a fire occurred in the main lead-covering shop in the cable manufacturing section of the works, and it was then decided to entirely reorganise the whole of the cable factory, and



A Modern Cable Factory Equipped by Johnson & Phillips.



An 18-Bobbin Stranding Machine.

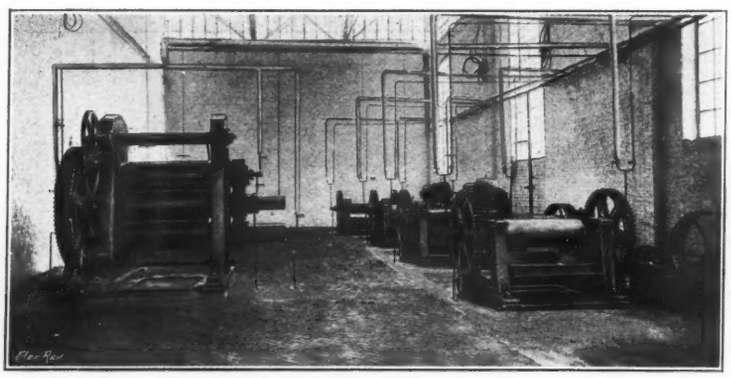


View showing Arrangement of Stranding and Armouring Machinery, supplied by Johnson & Phillips.

with this view the burnt-out shop was rebuilt and equipped as a vulcanised bitumen cable-covering shop and the erection of an entirely new factory, equipped with the most modern plant for the production of power, traction, lighting and telephone cables was decided upon. In any event this had become a necessity owing to the steadily-increasing demand for cables of the firm's manufacture, and it is the fact that in each year since the firm took up the manufacture of cables, there has been a very substantial increase in the output over the preceding one.

It was obvious that to be commercially successful the new works would have to be in a position to compete with the largest existing cable factories, and to be so arranged that they could produce the very highest grades of the types of cables for which there is a constant demand — viz., C.M.A. rubber cables for house wiring; Vulcanised bitumen cable for underground mains and collieries, for which it is specially

suitable owing to its moisture and acid resisting properties, and last, but not the least important, the works must be capable of accepting orders for large supplies of paper-



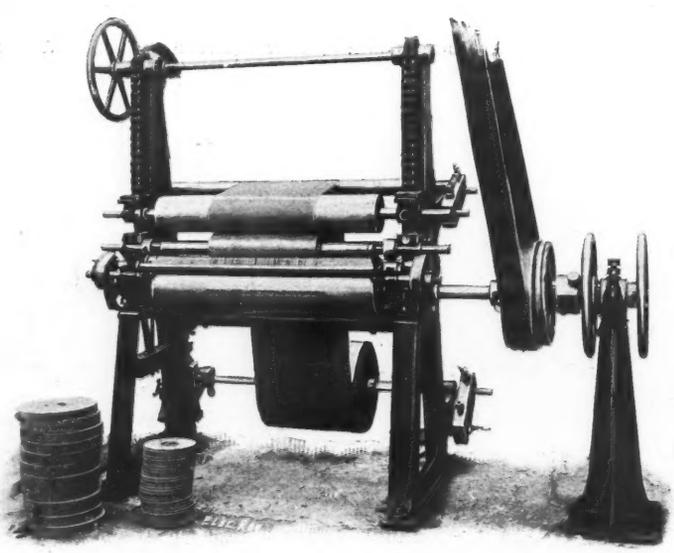
The Equipment of a Modern Rubber Department, showing Calendering Machinery.

insulated lead-covered cables for the transmission of energy, up to at least 20,000 volts pressure.

To carry out this somewhat extensive programme it was necessary for the company to acquire additional space, and negotiations were opened with a view to purchasing land adjoining the present works, but difficulties very soon arose owing the London County Council's by-laws not permitting a sufficiently large area to be covered in; fresh negotiations were then commenced with a view to the erection of a complete new factory outside the London district, plans being prepared for works at Ipswich. At this point, however, the Council granted a special permit to erect at Charlton, buildings some three times greater in area than those legally provided for in the London Building Act, and the directors, considering this the most economical scheme, decided upon the purchase of the land alongside the railway and the present extensive range of buildings were erected, the power being taken in bulk from the South Metropolitan Electric Light and Power Co.

Practically, the whole of the plant, both electrical and that for the manufacture of cable, has been manufactured by Messrs. Johnson & Phillips themselves. In the design and production of this type of machinery they have unique facilities, for not only do they manufacture cable-making machinery, but they have in daily use some hundreds of machines actually engaged in the manufacture of cable, enabling them continually to embody improvements in construction, for they are constantly experimenting with a view to increasing the output and efficiency of their machines, the idea being that the increased cost for an improved machine is amply repaid by more economical manufacture.

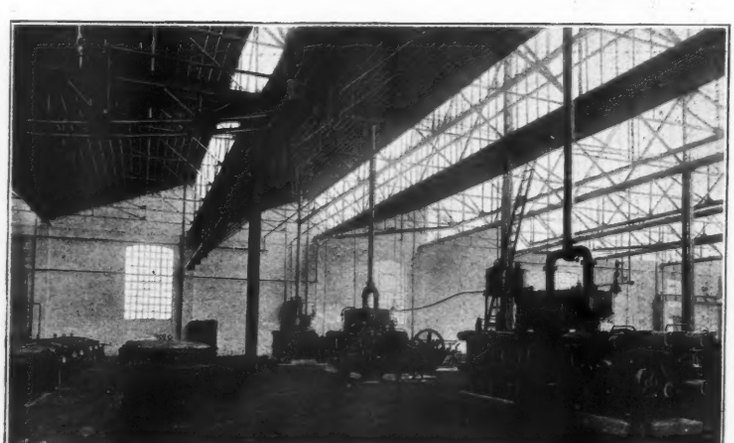
The firm specialise in the manufacture of this type of machinery, and it is not too much to say that they are renowned all over the world for the excellence of their cable-making machines. This is borne out by the fact that they have supplied their machinery to not only all the English cable-makers, but to cable factories in practically all the European countries, the United States of America, and a complete plant for a factory in go-a-head Japan, which will be the first of its kind in the East. In addition to their own new factory at Charlton, they have within the last year equipped a large cable factory on the Continent with machinery of the same design as that laid down in their own works. It is capable of turning out paper-insulated lead-covered cables, telephone cables, rubber cables and wires, &c., to the value of £600,000 per annum, and these works are now actually engaged upon the manufacture of extra high-tension three-core cables for a working pressure of 15,000 volts, the present order being for 58 miles.



A Modern Paper-cutting Machine by Johnson & Phillips.

The cable works at Charlton are divided into three sections :—

1. Vulcanised india-rubber cables and wires.
2. Vulcanised bitumen cables.
3. Paper-insulated lead-covered power, lighting and telephone cables.



Impregnating and Lead-covering Plant.

These latter cables are constructed in the new shops, to which the following notes mostly refer.

In the new shops the aim has been to commence the cable

at the one end, pass it through the intermediate stages to completion at the other, and though this is not possible with every class of cable, the object is practically attained owing to the high speed electric travelling cranes working over the whole area.

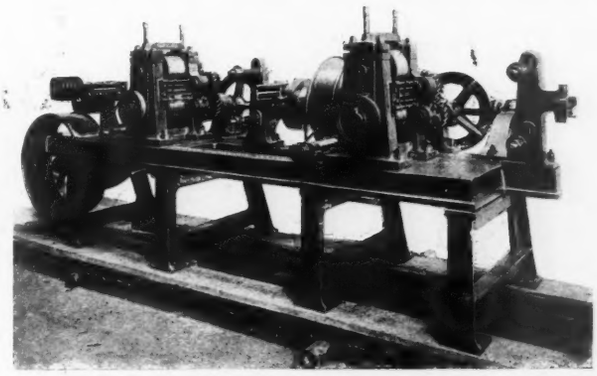
One of the most important machines is a large triple stranding machine, which can form copper wire strands up to 61 No. 8 wires in one operation, or to 127 wires in two operations, and also form the outer conductors of concentric cables up to 120 round wires, or any number of flat copper strips.

Close by is a wire-armouring machine for sheathing cables and putting on at same time protecting coverings of jute yarns and compound.

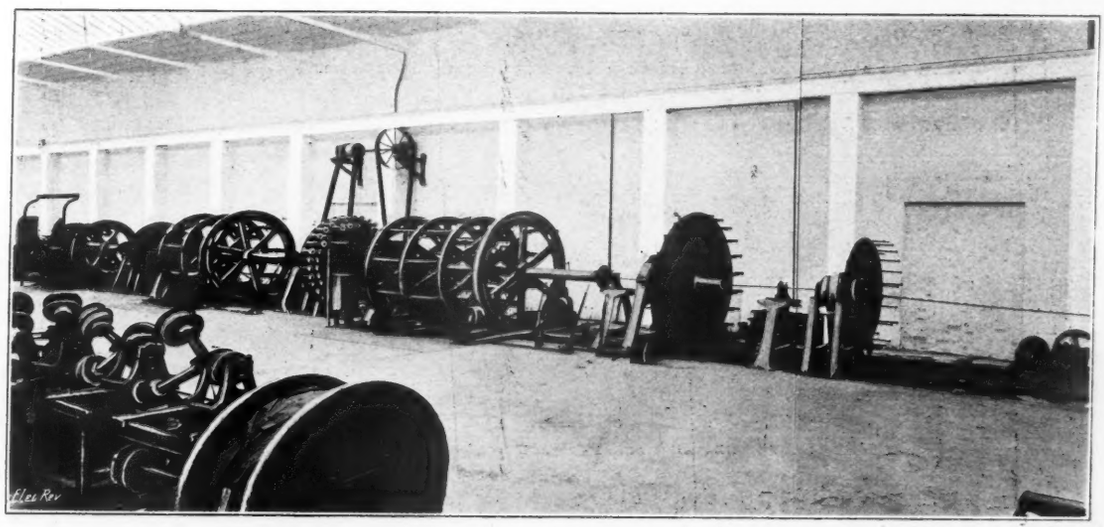
For making up the smaller copper conductors there are many smaller stranders having different numbers and sizes of bobbins for making strands of 6, 12, 19, 37 or 61 wires.

For three-phase and multiple-core cables there are large laying-up machines carrying six large bobbins for the main cores with smaller bobbins for the smaller cores, pilot wires and jute worming.

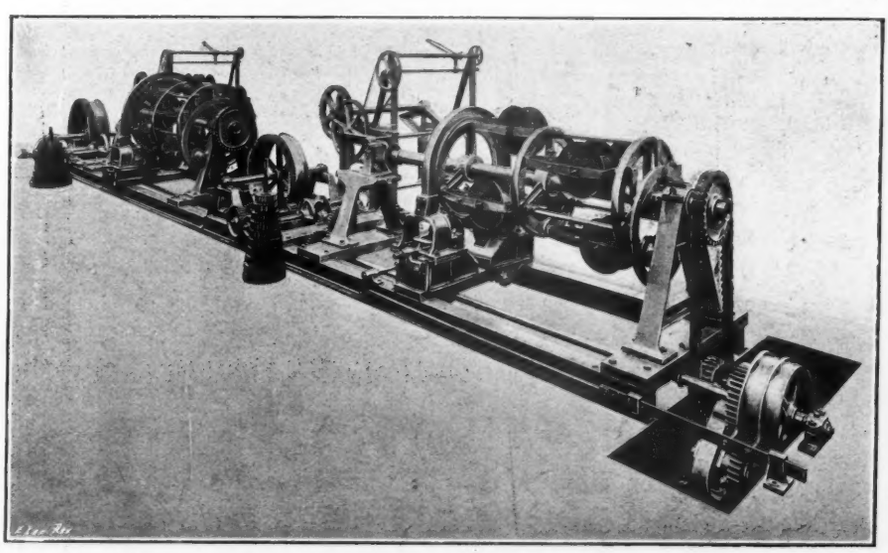
conductors and pilot wires up to $\frac{1}{2}$ in. diameter, several vertical machines are employed, each machine having four heads for covering four conductors simultaneously, and each head carrying 12 disks of paper.



A Longitudinal Robber-covering Machine.



A Compounding, Triple-stranding and Armouring Machine, Built by Johnson & Phillips.



Double-tandem Stranding Machine, with Two Take-up Gears.

These machines do very excellent work and at a high rate of speed, the heads running at 250 R.P.M.

A machine of special interest is the paper-cutting machine for cutting the disks of paper for the lappers.

This machine works at an extremely high speed, and in the space of 3 or 4 min. about 30 disks of paper about 12 in. dia. are cut, the cut face being absolutely smooth; and, in fact, the disks of paper look more like disks of wood that have been smoothed down with sand paper. This machine is a marvellously efficient one.

A row of large paper-lapping machines is installed, suitable for different sizes of cables and capable of putting on as many as 45 layers of paper simultaneously.

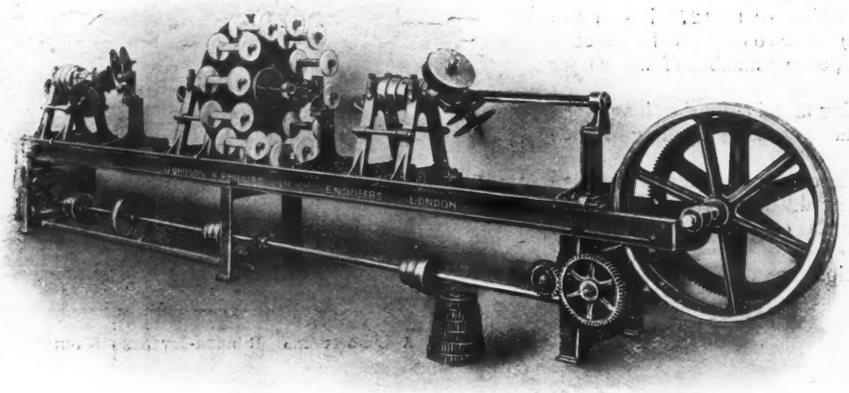
For putting the paper insulation on the smaller sizes of

Towards the middle of the bay there are several circular tanks for drying and impregnating the paper cables.

The tanks have steam heating coils around the sides and on the bottom, with trays at the centre to receive the cables.

The process of extracting the moisture under a vacuum, and subsequently impregnating with compound is familiar to our readers; when the cable is thoroughly impregnated the end of the cable is passed into the lead press, the cable being covered while it is still hot.

After the cable is lead covered, it passes to the testing tanks; the testing department is fully equipped with all the necessary instruments for carrying out the most stringent and exhaustive tests, and a notable item is the 100-KW. transformer, by which it is possible to test cables up to 100,000 volts pressure.



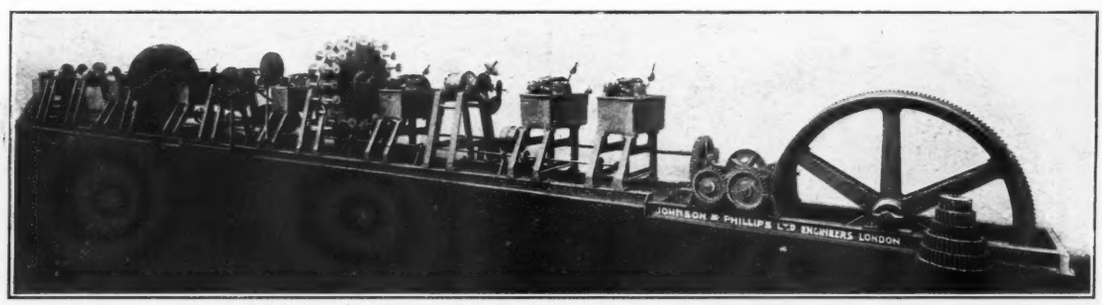
A Taping and Jute-serving Machine constructed by Johnson & Phillips.

When the cable has satisfactorily passed the various tests after the lead covering, it is usual—if it is to be laid in the ground—to armour it either with steel wires or steel tape, together with protecting covering of jute yarns or tape and compound.

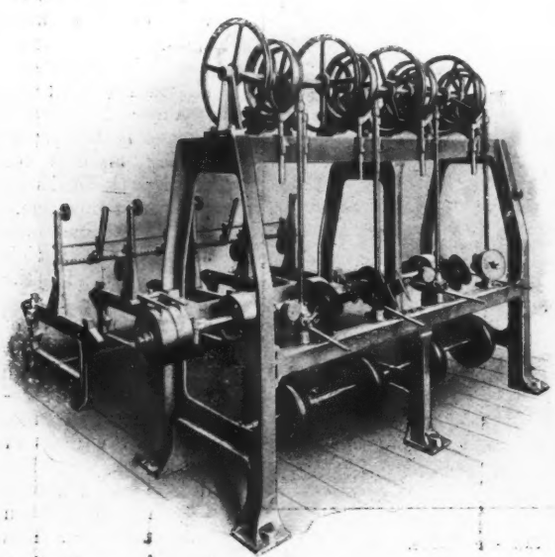
For this purpose it is taken to one of the wire-armouring machines before described, or one of the large steel tape sheathing machines.

A large installation of machinery for dry core and air space telephone cables also finds a place in the new shop.

The separate wires are passed through covering machines, each having eight heads through which the wire passes vertically.



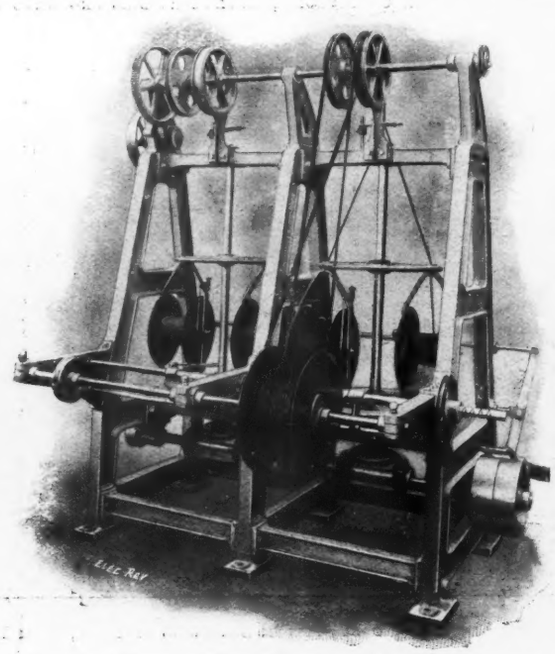
Steel-tape Sheathing and Yarn and Compound Serving Machine.



A Four-headed Vertical Taping Machine.

For the longitudinal paper covering there is a most ingenious "folder" which automatically folds the paper on to the wire as it passes through the machine forming a tubular paper covering.

The spiral covering is arranged to take place immediately



Twinning Machine (Two Heads) for Telephone Cables.

above the folder. A disk of paper is carried, concentric with the wire, on a revolving head running at about 1,000 R.P.M., and the paper is led from the edge of the disk through adjustable guides in such a manner that when once set, the disk of paper runs right out without further attention.

The wires so covered are coiled on to bobbins, ready to go into the twinning or pairing machines.

The twinning machines are of the vertical type, and the bobbin carriages are on the "floating" principle, so that no twist is put into the individual wires as they are twinned together.

These machines run at about 120 revolutions per minute. The paired wires are coiled directly on to the bobbins of the laying-up machines, which are of very novel construction; the largest machine comprises four sections, the largest section carrying 70 wide or 140 narrower bobbins, and this machine is capable of forming telephone cables up to 800 pairs (1,600 conductors), or more, if necessary.

The drying of the cables is effected in large cylindrical drying chambers about 7 ft. dia. × 15 ft. long, under vacuum, the process being similar to that adopted for the power cables, and similarly they then pass to the lead press for covering while hot.

Messrs. Johnson & Phillips also turn out large quantities of rubber cables in their older works.

In the rubber cable department there are wire stranding machines of various sizes—similar to those for the paper-insulated cables. Tinned copper wires are always used, so that the sulphur in the vulcanised rubber compounds shall not affect the copper.

Covering Machines.—Five longitudinal rubber covering machines, each arranged to cover 12 to 24 conductors simultaneously with three or four layers of rubber, are in use, as well as a much larger machine of the same type, which is arranged for covering large cables up to 2 in. diameter over the rubber. It will also cover two cables to 1½ in. dia. simultaneously, or 3 cables 1 in. dia., or 6 cables up to ⅝ in. dia.

This machine has five rubber covering heads and also a taping head, so that when a single cable is being made it can be taped at the same operation.

The capacity of these six machines is over 100 miles of rubber-covered wires and cable of various sizes per day.

To minimise the delay due to stoppages, a special arrangement of bracket and guide has been devised and adopted, which allows of much larger quantities of the rubber strip being put up at each head, thus reducing considerably the number of stoppages, and consequently increasing the output of the machine about three times. With the new arrangement it is possible to cover lengths of ¼ mile and more without a stop.

Where only small quantities or short lengths of rubber-covered cables are required, they can be made in machines of a cheaper form called rubber lapping machines, which put the layers of rubber on spirally.

The larger rubber-covered wires and cables are taped previously to vulcanising on horizontal taping machines, which are similar to the lapping machines.

For the smaller wires, vertical machines are used, each machine having four heads for taping four conductors simultaneously, running at about 500 R.P.M.

The vulcanising of these cables is performed by subjecting them to a certain temperature in steam-jacketed chambers for certain periods of time, according to the class of the cable.

In order to get the full advantage of the cubic capacity of these vulcanising pans, a system of telescopic drums has been devised and adopted, and as the drums nest in one another, about three times the usual quantity of cable can be vulcanised in one batch.

The taped and braided cables are saturated with thin compound, and then receive an outer covering of thick compounds, which are applied by passing the cables through steam-heated compound tanks.

For the smaller wires there are many cotton-covering machines, and hundreds of small braiding machines, turning out small covered wires, flexible leads, and copper wire braid, afterwards used as a single thread in other large braiders for covering cables with a braided copper armouring, largely used for a special purpose on Admiralty cables.

Very interesting also are some large wire braiders, which are engaged in putting the outer reinforcement of steel wires on Paterson's patent fire-proof cables.

These machines put on a braiding of 512 fine steel wires, the machine carrying 16 bobbins and each bobbin carrying 32 wires.

Special departments are devoted to the tinning of the copper wire and preparing the rubber.

An important branch of the firm's business is the manufacture of Paterson's vulcanised bitumen cables; the machines employed embody many special features recently introduced by Messrs. Johnson & Phillips.

TELEGRAPH and TELEPHONE NOTES.

(*Continued from page* 68.)

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo } Closed..	.. Jan. 12, 1906 ..	..
Lagos-Kotonon	.. Dec. 4, 1907 ..	..
Tarifa-Tangier	.. Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	.. Mar. 9, 1904 ..	..
Brest-Dakar	.. July 22, 1907 ..	..
Ceuta-Tangier	.. Dec. 7, 1907 ..	January 3
Scotland-Orkney and Shetland Islands ..	.. Jan. 2, 1908 ..	..
Bathurst-Bissao	.. Dec. 25, 1907 ..	..
Landlines.		
Puerto-Barrios	.. Aug. 2, 1909 ..	..

Wireless Telegraphy.—The Paris newspapers announce that success has now attended the experiments made to communicate between two French warships in the Mediterranean and the Eiffel Tower in Paris. The vessels concerned are the battleship *République* and the armoured cruiser *Jules Ferry*, which are at present cruising off the Algerian coast. During the trials it was found possible to exchange not only words, but also sentences enumerating the events of the day, the correspondence taking place both with the Eiffel Tower and with certain other stations, such as that at the Raz de Sein, on the most extreme coast of Brittany. The greatest range covered by the messages was 1,240 miles, and it is stated that the tests were made with the aid of a new method and apparatus. The experiments were made under the control of Admiral Gascard, and are being continued both between vessels and the shore, and between warships at considerable distances from each other.

Reuter reports that an Italian transport is proceeding to the ports on the Benadir coast, having on board the necessary plant for the erection of a wireless telegraph system between those ports and Zanzibar.

The steamship *Cap Blanco*, of the Hamburg-South America Line, on the voyage from Hamburg to Buenos Ayres, daily received telegraphic news from Nauen. The last telegram reached her at Teneriffe, when she was eight days out from Hamburg, at a distance of about 2,300 miles.

CONTRACTORS' COLUMN.

Openings for New Business.

ABERDARE.—Seventeen semi-detached villas at Gadlys, for Wayne's Building Club. A. S. Cameron, architect, 1, Glanant Street, Aberdare.

ABERIOUR (N.B.)—New Roman Catholic Church.

ABERTRIDWR.—New Calvinistic Methodist Chapel. G. A. Lundie, architect, 53, Queen Street, Cardiff.

ALRESFORD (Hants).—New buildings at Perin's Grammar School. Colson and Nisbet, architects, 45, Jewry Street, Winchester.

ANSDELL (near Lytham).—A new Roman Catholic school and Presbytery.

AUDENSHAW (near Manchester).—Offices, house, and works in Hanover Street, for A. Hopkinson.

BEDFORD.—Additions to Lynton Works, Southville Road, for W. H. Robertson & Co., Ltd.

Rebuilding of business premises in High Street, for W. Blott, draper.

Water motor house at St. Martin's Church.

Additions to Horne Lane Brewery, for Chas. Wells.

BLACKBURN.—Three new Council Schools in Cedar Street, Whalley Road, and Roe Lee.

BLACKPOOL (Fleetwood).—New Primitive Methodist Schools to be lit by electricity. Rev. E. Mather, Promenade Road, Fleetwood.

BLETCHINGLEY (Surrey).—Additions to residence, White Hill, for Dr. L. S. Settle.

BURY.—Extensions to Daisyfield Cotton Mills, Elton. Proposed by W. & J. Hutchinson, Ltd., owners.

(Lancashire).—Semi-detached houses in Mosley Street, for Alcimus Roscow.

(Lancashire).—Extensions to Convent Schools, Back Manchester Road.

BOLTON.—Additions to works at Turner Bridge, for T. Ryder & Son.
New cooling tower at Great Lever. Entwistle & Gass, engineers.
New pump house at Sunnyside Mills. Tostal, Broadhurst, Lee and Co.
Seven houses in Crescent Street. James Bromhall.
Eighteen houses, Hulton Lane, Deane. Mr. Higson.

BRIDGEND (PORTHCAWL).—Ten houses for the Porthcawl Building Club. G. F. Lambert and Son, architects, Prudential Buildings, Bridgend.

BRIDLINGTON.—New waterworks and plant for the T.C. (£11,500). F. J. Bancroft, engineers.

CASTLE DONINGTON (DERBYSHIRE).—Proposed renovation and extension of local church schools.

CAVAN.—New Town Hall. W. A. Scott, architect, 45, Mountjoy Square, Dublin.

CHATHAM.—Shipwrights' Arms to be re-built for Truman, Hanbury, Buxton and Co., brewers, Spitalfields, London.

CHELMSFORD.—Houses in Manor Road, for C. Choat.

CHORLEY.—Public slaughterhouse to be modernised.
Thirty-two houses in Mill Street, Coppull, for Liptrott and Holland.

CLACTON-ON-SEA.—New court house, &c. H. W. Gibson, Clerk of the Peace, Shire-Hall, Chelmsford.

CLITHEROE.—Fifteen houses for Henry Sharp.
New warehouse in Greenacre Street, for Standring & Son.

CORWEN (CARROG).—New elementary schools for the Welsh Campaign Committee. Deakin & Howard Jones, architects, Borth, R.S.O.

CREWE.—New Congregational Church at Hightown.
Six houses in Cromwell Street for Geo. Whitehead.
Business premises in Mill Street for W. Evans & Co.

CRICCIETH (CARNARVONSHIRE).—Houses for Capt. Griffith.

DERBY.—New stables for Lord Ellesmere. Inquiries to Capt. V. Hart-Davis, Bridgewater offices, Walkden, Manchester.

DEWSBURY.—New residence at Springfield. B. Watson, architect, Upper Taylor Street, Batley.

DIPTON (Co. DURHAM).—New police station for the C.C. W. Crozier, county surveyor, Shire Hall, Durham.

DONCASTER (EPWORTH).—Alterations at the George and Dragon Hotel, Crowle.

EASTBOURNE.—Houses at Langney Cemetery for the Burial Board. H. Sisley, builder, Langney Road, Eastbourne.

EAST COWES (ISLE OF WIGHT).—Houses in Adelaide Road. W. H. Brading and Son, builders, 10, Clarence Road, East Cowes.

EDINBURGH.—E.L. installation at Portobello Higher Grade School for the School Board. G. Thompson, A.M.I.C.E., 11, Randolph Place, Edinburgh.

ELLAND.—E.L. to be installed at the Congregational Church.

ELLESMERE PORT (near CHESTER).—Public house for the Cheshire Public House Trust Co.

ELTHAM.—Additions to building in King's Garden. Whistler & Worge, 80, High Street, Eltham, builders.

EPPING.—Houses in James Street for F. Wood.

EVESHAM.—New public hall (£6,000).

FARNWORTH (near BOLTON).—Rebuilding cotton mill for the Perseverance Mill Co.

FENTON.—Houses in Oldfield Street for J. Shenton.

HANLEY.—Place of worship. C. Corns & Son, builders, 111, Lithfield Street, Hanley.

HERNE (KENT).—New Parish Hall.

HEYWOOD.—New works for Yates, Duxbury & Son, paper manufacturers.

HOUGHTON CONQUEST (BEDS.).—New Council school. Gotch & Saunders, architects, 55, George Street, Luton, Beds.

HOUNSLOW.—Additional accommodation at hospital for nurses. H. R. Peake, secretary.

HUDDERSFIELD.—Residence at Crosland Moor and houses at Primrose Hill. J. Berry, architect, 3, Market Place, Huddersfield.
Semi-detached houses at New Royd, Linthwaite. J. Ainley, architect, Chapel Street, Slaithwaite.

ILFORD.—Residence in Seven Kings Road. Ward & Ward, 265, High Road, Ilford, architects.
Eight houses. E. Dunn, 7, Roding Street, Ilford, architect.
Six houses. A. R. Upsdale, 738, Romford Road, Ilford, architect.
Additions to laundry for Ilford Steam Sanitary Laundry Co. Bailey and Co., 3, Cranbrook Road, Ilford, surveyors.
New theatre at the corner of the Broadway and Ilford Lane, for Geo. Dance, 17, Shaftesbury Avenue, W.

INGATESTONE (ESSEX).—Houses and business premises for F. Segres.

LINGFIELD.—Additions to "Beechlands," Dorman's Land, for Mrs. Grove.

LLANDRINDOD WELLS.—Proposed new Police Station, County offices and other works for the Radnorshire C.C.

LONDON (HACKNEY, N.E.).—Rebuilding the Gun beerhouse. A. Dixon, c/o Whitbread & Co., Ltd., the Brewery, Chiswell Street, E.C., architect.
(HACKNEY, N.E.).—Shop in Chatsworth Road. Brand, Pettit & Co., 247, West Green Road, N., builders.
(CHELSEA, S.W.).—Flats in Royal Hospital Road. G. H. and A. Bywaters & Sons, Ltd., Kingley Street, Regent Street, W., builders.
(VICTORIA, S.W.).—Shops, showrooms, &c., in Buckingham Palace Road. Trollope & Sons, 7, Hobart Place, S.W., agents.
(W.).—Block of flats in Portland Place. F. Verity, 7, Sackville Street, W., architect.
(HIGH HOLBORN, W.C.).—Rebuilding premises. Coker & Co., 2, Lismore Road, Maldon Road, N.W., contractors.
(BATTERSEA, S.W.).—Warehouse in Vicarage Road, for J. Rank, Ltd., flour millers. J. Carmichael, Wandsworth Common, S.W., builder.
(NINE ELMS, S.W.).—Factory at Imperial Wharf for Crosse and Blackwell, Ltd. Roumieu & Aitchison, architects, 10, Lancaster Place, W.C.
(WIMBLEDON).—Workshop in Braemar Avenue. C. Barwell, The Elms, Morden, Wimbledon.
(WIMBLEDON).—Thirty-six dwelling houses. C. Barwell, The Elms, Morden, Wimbledon.
(E.C.).—Extensions to premises of J. Haddon & Co., 119, Salisbury Square, E.C.
(LEYTON).—Two shops. A. C. Turner, 55, Eton Road, Ilford, surveyor.
(LEYTON).—Six houses. J. W. Abraham, 123, Francis Road, Leyton.
(LEYTON).—Additions and alterations to premises in Lea Bridge Road. Clemens Bros., York Road, East Ham, builders.
(LEYTON).—Laboratory in Connaught Road. W. Jacques, 2, Fencourt, Fenchurch Street, E.C., architect.

LONDONDERRY.—Alterations and improvements at the Workhouse. A. Robinson, Richmond Street, Derry.

LONGRIDGE (near PRESTON).—Important additions to be made to St. Paul's Church.

LONGTON.—Additions to works for T. C. Wild, china manufacturer, High Street, and Aynesley & Son, china manufacturers, Portland Works.

MANCHESTER (HULME).—Municipal dwellings for Manchester T.C. (£28,150).

NEWCASTLE-UNDER-LYME (STAFFS.).—Alterations to the Theatre Royal.

OLDHAM.—New spinning mill at Busk. J. Smethurst, builder, Oldham.

OXTED (SURREY).—Residence at Stoodhurst Park. Martin & Son, builders, Oxted.
Houses for C. H. Master, D.L., J.P., Mr. Wheeler and S. H. Wells.

PITLOCHRY (N.B.).—Proposed Parish Hall in connection with Pitlochry Established Church (£1,000).

PLUMSTEAD.—Additions and alterations to All Saints' School. R. Coombes and Sons, 213, Eglinton Road, Plumstead, builders.

PRINCES RISBOROUGH (BUCKS).—Development of Culverton Estate for building.

PONTYPRIDD.—Administration offices in Court House Street. W. Spickett, clerk to the Guardians, Union Offices, Pontypridd.

READING.—New Church at Spencer's Wood. S. Slingsby Stallwood, architect, 27 and 28, Market Place, Reading; Chas. Aldridge, builder, Spencer's Wood, Reading.

SACRISTON (Co. DURHAM).—New Council Schools.

ST. ALBANS.—Alterations to Cathedral (£4,500).

ST. ANNE'S-ON-THE-SEA.—Alterations and additions to local Council offices; Town Hall proposed.

SEVEN KINGS.—Alterations and additions to 46, The Promenade, Seven Kings. E. Dunn, 7, Roding Street, Ilford, architect.

SLOUGH.—New place of worship in Curzon Street. B. Williamson, architect.

SMETHWICK.—New licensed premises in Waterloo Road for Mitchells and Butler, Ltd., brewers, Smethwick.

SOUTHAMPTON.—New Council Schools at Swaythling. W. J. Taylor, surveyor, The Castle, Winchester.

SOUTHPORT.—Extensive alterations to premises of the *Southport Guardian*, Lord Street. Proprietor, J. J. Riley.
(AINSDALE).—New railway station for the Lancs. and Yorks. Railway Co. Engineer's Office, Hunt's Bank, Manchester.

STOPSLEY (BEDS.).—New Council Scoools. Gotch & Saunders, architects, 55, George Street, Luton, Beds.

STONEHOUSE (GLOS.).—New Baptist Church. F. G. Faunch, architect, 76, Cranbrook Road, Ilford; A. R. Blick, builder, Stonehouse.

SWANSEA.—Lighting of London and North-Western railway sidings by arc lamps.
Rebuilding of premises in Union Street. C. T. Ruthen, architect, Bank Chambers, Heathfield Street, Swansea.

TREORKY.—New hall and caretaker's house for the Committee of the Workmen's Institute. J. Rees, architect, Pentre, Rhondda.

TUNSTALL (STAFFS.).—Pottery factory and flint mill. A. R. Wood & Son, architects, Tunstall and Burslem.

WALKDEN (MANCHESTER).—Development of new mines for the Earl of Ellesmere.

WELLINGBOROUGH.—New girls' grammar school for the Governors (£7,500).

WESTHOUGHTON (LANCS.).—New works for making bone articles, for Mr. Wallwork.

WESTON-SUPER-MARE.—Proposed new Council schools.

WHALEY BRIDGE (NEAR STOCKPORT).—New billiard and reading rooms, &c., for the Whaley Bridge Bowling Green Co, Ltd. S. Bailey, architect, Whaley Bridge.

WHALLEY (LANCS.).—Extensions to be carried out at the Victoria Mill.

WOLVERHAMPTON.—Rebuilding of Harley's Liquor Vaults, corner of Queen Square and Victoria Street for a local syndicate.

YORK.—New works for H. Leetham & Sons, Ltd., millers, York (£10,000).

CONTRACTS OPEN and CLOSED.

OPEN.

Ashton-under-Lyne.—The B. of G. proposes to lay down electric light plant for the new hospital and nurses' home, at an estimated cost of £2,250.

Australia.—ADELAIDE, SOUTH AUSTRALIA.—March 11th. The Postmaster-General requires tenders for the supply of one common-battery switchboard, 400 subscribers' telephones and 400 protectors.

The Postmaster-General has been authorised by the Commonwealth Cabinet to call for tenders at once for the installation of wireless telegraphy on several places round the coast of Australia. The places to be linked up are King's Island and Tasmania, Rottnest and some convenient centre on the north-west coast, and Port Moresby and Yorke's Peninsula. The tenderers will be required to sell the Australian rights of their system right out to the Commonwealth Government.

MELBOURNE.—January 21st. Supply and delivery of 250 visual vibrating indicators, for which tenders will be received at the office of the Deputy Postmaster-General, Melbourne, up to 3 p.m. on January 21st. Copies of the specification, tender form, &c., may be obtained at the Commonwealth Offices in London, 72, Victoria Street, S.W., or inspected at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C.—*Board of Trade Journal.*

MELBOURNE.—May 26th. The Postmaster-General invites tenders for a common battery switchboard, together with all associated frames, racks, power plant and parts and apparatus for consumers. See this column for January 3rd.

Austria.—Tenders are about to be invited for the establishment of a municipal central electric lighting station in the town of Ladis-lez-Laudek.

Belgium.—February 1st. The municipal authorities of Ghent are inviting tenders for the supply of 30 electric cranes, and the erection of the same along the new dock. Particulars may be obtained from, and tenders are to be sent to, L'Hotel de Ville, Ghent.

Cape Colony.—SIMON'S TOWN.—The proposed agreement for lighting the streets with gas having been cancelled, the Town Council last month decided to invite offers of schemes for supplying private consumers and lighting the town with a suitable illuminant, or a scheme for lighting the town only.

Cardiff.—January 23rd. Extra-high-tension three-phase feeder cable, and one 500-KW. motor-generator for the Corporation. See "Official Notices" to-day.

Czernowitz.—January 20th. Tenders are open until January 20th for an electrically-driven water-pumping station. Particulars may be obtained from the K.K. Betriebs Leitung.

Finchley.—January 20th. One 350-KW. high-speed engine and dynamo, &c., for the Council's electricity works. See "Official Notices" December 20th.

France.—LYONS.—January 15th. The municipal authorities of Lyons are inviting projects for the establishment of a combined refuse destructor and electric power generating station.

PARIS.—January 14th. The Colonial Office requires tenders for galvanised insulator supports. Tenders to Directeur, 3, Rue Flydeau.

PARIS.—The Post and Telegraph Department, 103, Rue de Grenelle, invites tenders for the supply of copper and bronze wire required for the Algiers service.

Germany.—Tenders are about to be invited for the establishment of a municipal central electric lighting station in the town of Wedel (Holstein).

Glasgow.—January 14th. Turbo-alternators of 4,000 KW. output. See "Official Notices" January 3rd..

Great Yarmouth.—February 1st. One 400-KW. C.C. traction steam generator for the Electricity Department. See "Official Notices" to-day.

Holland.—January 14th. The municipal authorities of Nimegen are inviting tenders for the supply and erection of three boilers, with superheaters and economisers, at the central electric lighting station.

Kilkenny.—January 18th. Suction gas plants, gas engines, electric generators, battery, switchboard, mains, wiring, &c., for the District Lunatic Asylum. See "Official Notices" December 20th.

Klagenfurt.—The municipal authorities require tenders for electricity plant extensions, valued at 500,000 kronen.

Manchester.—January 14th and 20th. The Tramways Committee requires tenders for various machine tools by January 14th, and for mackintoshes, leggings and sou'-westers by January 20th. Particulars from the General Manager, 55, Piccadilly.

Manila.—January 15th. Sewage pumps to be worked by electric motors are required by the municipal authorities.

Plymouth.—January 23rd. Stores for the Corporation Electricity Department. See "Official Notices" January 3rd.

Rangoon.—March 31st. The Revenue Secretary of the Burma Government will receive tenders for the concession for 30 years, renewable for a further period of 20 years, for rubber plantations at Mergui (Tenasserina).

Russia.—The *Financial News* says that the St. Petersburg Municipality requires 57 electric tramcars and 210 trailers, to cost about £296,000.

Spain.—January 17. Tenders are being invited by the municipal authorities at Toro (province of Zamora) for the concession for the electric lighting of the town during a period of 10 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento of Toro (Zamora).

Spezia.—January 16th. The General-Direction of the Royal Arsenal requires tenders for four lifts, estimated to cost £1,600; a deposit of £160 is required. Tenders by January 16th.

Wimbledon.—February 18th. One 1,000-KW. turbo-alternator, with condensing plant; two water-tube boilers, economisers, pipe-work and feed pump; switchboard and switchboard gallery for the Corporation electricity department. See "Official Notices" to-day.

CLOSED.

Buenos Ayres.—According to the *Review of the River Plate*, Messrs. Buxton & Cassini have obtained the contract to supply Government House with electric lifts at a cost of $25,454.54 paper.

Canterbury.—The T.C. has appointed Mr. E. J. Philpot, of St. George's Street, Canterbury, to execute electrical engineering work during the ensuing half-year.

Cape Town.—The tender of Messrs. Woods, Monahan and Co. for the electric lighting of the British Temple Masonic Lodge has been accepted. Mr. W. G. P. MacMuldrow is the consulting engineer.

Cardiff.—Messrs. Bruce Peebles & Co., Ltd., have received from the Corporation an order for a 250-KW. Peebles-La Cour motor converter, this being a duplicate of the unit previously ordered.

Darwen.—The electrical engineer having tested coal required for the local electricity works, the Town Council has accepted the tender of the Clifton and Kearsley Coal Co. for a six months' supply.

Leyton.—The U.D.C. has received the following tenders for the supply of cables for extensions to mains:—

Lahmeyer Electrical Co.	(accepted)	£1,785 10 0
Western Electric Co.		1,872 10 0
British Insulated and Helsby Cables, Ltd. ..		1,904 13 0
Johnson & Phillips, Ltd.		1,909 10 0
Siemens Bros. & Co.		1,910 11 0
W. T. Henley's Telegraph Works Co.		1,924 0 0
St. Helens Cable and Rubber Co.		1,947 0 0
Callender's Cable and Construction Co.		1,955 10 0

The tender of Messrs. Mountain & Gibson, Ltd., was accepted for the supply of car wheels, at £3 17s. 6d. each, wheel tires, at £1 17s. 6d., and wheel centres, at £2 each, a reduction of 1s. per tire being made for 2-in. tires. The following tenders were received for the supply of 100 public lighting lanterns:—

W. Edgar, £2 9s. 3d. per lamp, or	£246 5 0	per hundred.
Electrical Co.	525 0 0	,,
W. Lucy & Co., Oxford	240 16 0	,,
General Electric Co.	250 0 0	,,
Crown Lamp Works	360 0 0	,,

The tenders were referred to the Electric Lighting Committee for consideration.

London.—The Metropolitan Asylums Board has entered into an agreement with the Electrical Power Storage Co., Ltd., for the maintenance of the storage battery at Brook Hospital, Woolwich, for seven years, for £70 per annum.

STEPNEY.—Messrs. Bruce Peebles & Co., Ltd., have secured through Messrs. Willans & Robinson, the Stepney Borough Council's order for a 2,000-KW. 6,000-volt 50-cycle three-phase turbo-alternator, to be driven at 1,500 R.P.M. by a Willans & Robinson's steam turbine.

WOOLWICH.—The B.C. has accepted the quotation of the Oliver Arc Lamp Co., Ltd., for the annual supply of 35,000 pairs of "Oriflame" arc lamp carbons for continuous-current supply, at £96 5s., and 10,000 pairs for alternating-current supply, at £28 10s., has been accepted.

Manchester.—The E.L. Committee has accepted tenders from the under-mentioned firms:—

Ferranti, Ltd.—High-tension feeder-panel at Oldham Road sub-station.
Connolly Bros., Ltd.—Single-conductor cable, and low-tension service cables.
British Insulated and Helsby Cables, Ltd.—Single-conductor low-tension and extra high-tension cables.
Bruce Peebles & Co., Ltd.—Motor converters at various substations.

The following tenders have been accepted by the Tramways Committee:—

The Morgan Crucible Co., Ltd.—Two Morgan Patent tilting furnaces for the purpose of making cast-iron-bound crossings.
John Shaw & Sons.—A hydraulic armature press.
F. Smith & Co., Ltd.—10 miles of hard-drawn copper trolley wire.
Smith & Forrest.—1,800 tons of pitch.

Monte Video.—A Buenos Ayres exchange says that the Uruguayan Government has accepted the tender of Messrs. Felten and Guilleaume for the supply of 39 kilometres of cable for the Monte Video electric light station.

MILAN EXHIBITION, 1906.

On Wednesday last the awards to the British Commissioners, Jurors and Exhibitors were distributed by Count de Bosdari, of the Italian Embassy, at the Mansion House. The Lord Mayor occupied the chair and opened the proceedings, referring to the traditional close friendship between Italy and the United Kingdom.

The Hon. President of the British Commission, Sir Albert Rollit, expressed the indebtedness of the Commission to Mr. Arthur Serena, the Hon. Executive Commissioner, and his assistants, Messrs. H. E. P. Cottrell and J. H. Cundall. He remarked that the work of the jury was most carefully done, as was proved by the large number of awards to British exhibitors. He admitted that participation in exhibitions was expensive and troublesome to exhibitors, but urged that they should be patriotic and do their best. Throughout Milan English goods were prominently shown, and "English make" was a high recommendation. As the result of the Exhibition, our exports to Italy had increased from £9,800,000 in 1905 to £12,500,000 in 1906, and our imports from Italy from £3 300,000 to £3,600,000.

Mr. Serena then read his report, which stated that the Exhibition was international but not universal, and the regulations restricted the exhibitors in many important groups, notably in machinery, which operated very unfavourably to Britishers in many directions. The total area of the Exhibition grounds amounted to 247 acres, on which were erected 220 pavilions, with a covered area aggregating 334,900 sq. yards, which compared with some 528,000 sq. yards covered by the Paris Exhibition (1900) and 155,480 by the Liége Exhibition (1905). The Exhibition was visited between April 28th and November 11th, a little over six months, by some six million people, with a daily average of about 30,000, whilst on several occasions it exceeded 100,000.

When the Government intimated that £10,000 would be available for the purpose, and the British Commission was formed, many possible exhibitors found there would not be sufficient time in which to make suitable exhibits, whilst others were excluded by the rigid enforcement of the regulations already referred to. Notwithstanding these difficulties, a fairly extensive display of British industries was made, the total area occupied amounting to 77,000 sq. ft. The exhibits of this country were second to none as regards high character and quality, which was conclusively proved by the number and value of the awards bestowed by the International Jury. The British exhibitors formed only 2·63 per cent. of the total, but they carried away 3·34 per cent. of the awards, principally in the higher degrees.

In all, Great Britain obtained:—9 Hors Concours, 99 Grands Prix, 50 Diplomes d'Honneur, 96 Gold Medals, 53 Silver Medals, 19 Bronze Medals, 8 Hon. Mention—a highly satisfactory record.

In addition, 96 Complimentary Diplomas were offered to Government Departments, Public Institutions, and members of the British Commission and of the Jury, and 105 Awards of varying degree were made to what are known as "Collaborateurs," whilst a special Gold Medal was given to the Hon. Charles A. Parsons for his development of the steam turbine.

The funds at the disposal of the British Commission were handled with the strictest economy, and, as much honorary work was done, the expenses were greatly curtailed. The total revenue was about £13,800 and the expenditure about £9,000. An allowance in the shape of 25 per cent. on the amounts severally paid by the exhibitors for space was returned to them, and those who had been awarded diplomas received medals presented by the Commission. The surplus of £4,700 was returned to the Treasury.

Count de Bosdari, in the absence of the Italian Ambassador on account of a family bereavement, referred to the importance of Great Britain's participation in an exhibition, and said that the gratification of the authorities was shown by the number of awards to British exhibitors.

The awards were then distributed, the following firms, in addition to the officials, jurors, and institutions, being amongst the recipients of commercial awards:—

Armorduct Manufacturing Co., Ltd., Silver Medal, Bronze Medal.
Sir Wm. G. Armstrong, Whitworth & Co., Ltd., Hors Concours, Grand Prix.
Aveling & Porter, Ltd., Grand Prix.
Babcock & Wilcox, Ltd., Grand Prix.
Barclay, Curle & Co., Ltd., Bronze Medal.
Wm. Beardmore & Co., Ltd., Diploma of Honour.
Beldam Packing & Rubber Co., Gold Medal, Silver Medal.
Berry, Skinner & Co., Gold Medal. Bronze Medal.
British Electric Transformer Co., Ltd., Gold Medal.
John Brown & Co., Ltd., two Grands Prix.
Cambridge Scientific Instrument Co., Ltd., two Grands Prix.
Combination Metallic Packing Co., Ltd., Gold Medal.
F. Darton & Co., Grand Prix, Diploma of Honour, Hon. Mention.
Doulton & Co., Ltd., Grand Prix, Gold Medal.
A. Edmeston & Sons, Silver Medal.
Elliott Bros., two Grands Prix.
Frictionless Engine Packing Co., Ltd., Gold Medal, Silver Medal.
Glenboig Union Fireclay Co., Ltd., Diploma of Honour, two Gold Medals.
Greenwood & Batley, Ltd., Diploma of Honour.
Alfred Herbert, Ltd., Grand Prix.
A. P. Lundberg, Gold Medal.
Marshall, Sons & Co., Ltd., Grand Prix.
Nalder Bros. & Thompson, Ltd., two Diplomas of Honour.
Hon. Chas. A. Parsons, Hors Concours.
Ruston, Proctor & Co., Grand Prix.
Edwin O. Sachs, Silver Medal.
Sir David L. Salomons, Bart., Silver Medal.
Shand, Mason & Co., Ltd., Grand Prix.
Simplex Conduits, Ltd., two Gold Medals, Silver Medal.
Stirling Boiler Co., Ltd., Gold Medal.
United Alkali Co., Ltd., Grand Prix.
Vickers, Sons & Maxim, Ltd., Grand Prix.
Whitecross Co., Ltd., Diploma of Honour, Gold Medal.
Willans & Robinson, Ltd., Grand Prix, Silver Medal.
Worthington Pump Co., Ltd., two Grands Prix.

The proceedings concluded with votes of thanks to the Italian authorities, the British jurors, and the Lord Mayor.

FORTHCOMING EVENTS.

To-day's Events (Friday, January 10th).—At 7.30 p.m. At Newcastle-upon-Tyne. Discussion on Mr. W. G. Spence's paper on "Notes from Four Years' Working of the Education Committee's Recommendations."
At 8 p.m. At the Holborn Restaurant. Electro-Harmonic Society. Smoking Concert.

Saturday, January 11th.—At 3 p.m. Junior Institution of Engineers. Visit to the L.C.C. tramway reconstruction work in South Lambeth Road, and motor school; car-shed and sub-station at Clapham.
At 3 p.m. Liverpool and District Electrical Association. Visit to Liverpool Corporation Lister Drive power stations.
At St. Bride's Institute. Association of Engineers-in-Charge. Social Dance.
Rugby Engineering Society. Excursion to inspect Franco-British Exhibition Buildings.

Monday, January 13th.—At 8 p.m. Institution of Mechanical Engineers (Graduates' Association). Mr. A. J. Aitken on "The Manufacture of Constructional Steelwork."
At 8 p.m. At Armstrong College, Newcastle-on-Tyne. Institution of Electrical Engineers (Newcastle Local Section). Paper on "Electrical Power in Railway Goods Warehouses," by Mr. H. Henderson.

Tuesday, January 14th.—At 8 p.m. Liverpool and District Electrical Association. Mr. J. Greenhalgh on "Fuel Economy in Steam Generating Plants."
At 7.30 p.m. The University (Physical Laboratory), Manchester. Institution of Electrical Engineers (Manchester Section). "Magnetic Oscillations in Alternators," by Mr. G. W. Worrall. [The meeting announced for January 7th is postponed to this date.]
At 8 p.m. Institution of Electrical Engineers (Glasgow Section). "Cost of Electrical Power for Industrial Purposes," by Mr. J. F. C. Snell.

Wednesday, January 15th.—At 7.30 p.m. Institution of Electrical Engineers Students' meeting. "Electrification of the Mansfield Copper Mines," by Mr. H. R. Speyer.

Friday, January 17th.—At 9 p.m. Royal Institution. Prof. T. E. Thorpe, C.B., &c., on "The Centenary of Davy's Discovery of the Metals of the Alkalis."
At 8 p.m. Storey's Gate, S.W. Institution of Mechanical Engineers. Third Report to the Gas Engine Research Committee, by Prof. F. W. Burstall.

Saturday, January 18th.—At 3 p.m. Royal Institution. Prof. Gisbert Kapp on "The Electrification of Railways." (Lecture I.)
At 10 a.m. Institution of Electrical Engineers. Students' visit to Messrs. Elliot Bros.' works. Students wishing to join the party should apply at once to Mr. W. B. Thompson.
At 7 p.m. Birmingham and District Electric Club. Presidential address by Mr. E. C. R. Marks.

NOTES.

Lord Kelvin and the British Aluminium Co., Ltd.—On December 18th the directors of the British Aluminium Co., Ltd., resolved to send to Lady Kelvin an expression of their deep sympathy with her on the death of their honoured and esteemed colleague, Lord Kelvin. In their resolution bearing upon the matter, they placed on record "their high appreciation of the great services rendered by him in connection with the introduction and development of the aluminium industry in this country, and they feel that the British Aluminium Co., with which he had been connected since its formation, has sustained an irreparable loss." The Chairman, Mr. John D. Bonner, was desired to represent the company at the funeral.

Signalling to Trains in Germany.—The over-running of signals at danger in Germany, particularly in foggy weather, has brought forward the question, as in the United Kingdom, of transmitting signals to the cab of the locomotive itself. But whilst the British schemes in general aim at the reproduction in miniature on the cab of the actual position of the semaphores arranged along the railway ahead, it would appear that the Teutonic idea is merely to show to the driver, by means of an apparatus in front of him, that he must expect to reach a signal in less than a distance of 100 metres in advance, and that he should, therefore, take precautions to stop the train and proceed to the signal post for the definite instruction. The reason for the German abstention from intimating to the driver on the cab the exact position of the signals is said to lie in the belief that if he had no signals to observe outside his cab, the attention which he should devote to the track would considerably diminish. It is also held that the look-out from the locomotive, which is unconditionally necessary for the safety of the train, would gradually be abandoned

altogether, and observations would only be made of the indications given by the small apparatus on the locomotive. However this may be, the new signalling apparatus, which is coming into use on several railways, only aims at drawing the driver's attention by a visual signal on the cab to the fact that a signal will be met in a very short space of time. The system consists in the installation at a definite distance from each ordinary track signal of two parallel iron bars several metres in length, having a slight space between them, and laid near the track. From the locomotive projects an arm which carries a brush formed of flexible copper wires, and the brush is led through the space between the bars while passing them. This operation completes an electric circuit on the cab and causes a bell to ring and a red disk to be substituted for a white one. The acoustic and visual signals remain in action until the driver, by pressing a button, disconnects the circuit. It is stated that the contact between the copper wire brush and the bars fixed near the track is entirely free from shock, the flexible arrangement having accomplished what was impossible with rigid contact pieces. It has, in fact, been found by experiments that no rigid contacts are able to withstand the impact, especially at high railway speeds.

Prices of Electrical Energy in Italy.—Our contemporary, *Electricity*, of Milan, has published a table arranged by Prof. Giusti, of Florence, showing the comparative cost of electrical energy and gas for the principal cities in Italy. The prices are given in centimes per hectowatt-hour, but for convenience we give them reduced to pence per Board of Trade unit:—Como, 4·76d.; Genoa, 8·6d. to 3·8d.; Mantua, 9·65d.; Modena, 7·15d.; Monza, 6·7d.; Naples, 6·7d.; Parma, 4·76d. for lighting, 2·38d. for power; Rome, 6·7d.; Spezia, 7·65d. to 4·8d.; Turin, 8·6d. to 6·05d. Milan is left blank, as apparently the scale of prices to consumers is too extensive to fit into the space available. In view of the fact that many of the installations are worked by hydraulic power, the figures do not compare as favourably with home prices as might have been anticipated.

Paisley Tramways Ambulance Corps.—Arrangements have been completed for a section of the Paisley District Tramway Ambulance men to man one half of Maryhill Barracks, Glasgow, for ambulance work in the event of war; they are fully equipped in transport, with a baggage wagon under the charge of a thoroughly qualified veterinary department man, and have a complete kit, including blankets, &c., so that within 1½ hours of receiving a telegram they can be on the road to Maryhill, while amongst their members are all that the War Office asks in the shape of trained army cooks, &c.

On Christmas Day the children (to the number of 100) of the employés of the Paisley District Tramway Co. met in the Recreation Hall for their Christmas Tree Treat, after which they and their parents were conveyed home in special cars.

Electric Railway Prize Competition.—The Association of German Mechanical Engineers (Verein Deutscher Maschinen Ingenieure), of Berlin, has received five schemes in competition for the Beuth prize for 1907. The contests annually instituted by the Association are claimed to possess a certain official character, inasmuch as they always bear relation to Government projects which have a prospect of being carried out within a conceivable period. In the case of the past year the subject selected as the basis of the competition was the proposed conversion to electric traction of the Berlin city, circle and suburban railways. It was laid down that competitors should select as the site of the power station a locality having railway and water connection in the vicinity of the Furstenbrunn station of the Berlin-Spandau suburban railway on the right bank of the Spree. The power station was to be laid out for a maximum capacity of 40,000 KW. and an annual output of 150,000,000 KW.-hours, and to be equipped with single-phase generators each of 8,000 KW. and 25 periods at a pressure of 10,000 volts. The generators were to be driven by steam turbines, running at 750 R.P.M., and provision was to be made for two units as reserve plant. The electrical energy was to be delivered direct, it is stated, at the generator pressure into the lines near the station, and by means of feeders at high pressure to the most distant sections of the railways. The Government prize of £85 and the Beuth gold medal have been awarded to Herr Arthur Schalkau; and a Beuth gold medal has also been presented to Herr Alfred Buntebardt. It is intended to submit all the five schemes for the consideration of the Prussian Minister of Public Works and Railways.

From the Emerald Isle.—*Stranded Staff. Story of Electric Lighting Contracts in Ireland.*—The *Morning Leader* of Monday last is responsible for the following remarkable story:—"Two enterprising American electrical speculators engaged in putting up installations in two small towns in the South of Ireland have disappeared. It appears that the pair set up offices in Dublin, and engaged a staff of electricians, some of whom, it is said, invested money in the business. They also engaged some apprentices, who paid big fees, and in both places they secured the work of fixing the installations. In one town, it is stated, a considerable advance was made to the partners, and many residents gave the speculators orders to have their houses connected with the system. Eventually the streets of the town were lighted with the new illuminant. Then, it is alleged, the speculators failed to appear, and the staff were left without their wages, and returned to Dublin to find the offices empty. Both ventures were good business speculations, and should have eventually paid handsomely."

St. James's Electric Cricket Club.—The annual concert of this club is to be held to-morrow, Saturday evening, at 7.30, at Anderton's Hotel.

Thomson-Houston Harriers (Rugby).—On Saturday last over 80 runners, representing Sparkhill, Leamington, Hinckley, Coventry, Willans & Robinson, Thomson-Houston, Thrapston and Walsall, turned out for the second annual seven miles cross-country race promoted by the Thomson-Houston Harriers. We understand that although only the second "annual," it now ranks as the largest and most interesting competition of its kind in the Midlands, excepting only the Junior and Senior Championships. Saturday's race proved a big attraction for Rugby people, and many hundreds lined the Station Road to see the start and finish. W. Coales, of Thrapston, was first man home, followed by Noakes and Hart, of Sparkhill. The following were the placings of the clubs engaged:—(1) Thrapston; (2) Sparkhill; (3) Thomston-Houston; (4) Coventry Godiva; (5) Leamington; (6) Willans & Robinson; (7) Hinckley; (8) Walsall. Arthur Russell, captain of the Thomson-Houston Harriers, and ex-Champion Steeplechaser of England, was out with a view to putting in some training for the Olympic Games at London next summer, when he will represent his club in the Steeplechase Championship of the World. Mr. T. N. Martin, the hon. sec. of the Thomson-Houston Harriers, is anxious to hear from the hon. secs. of works clubs, with a view to arranging some inter-works athletic contests, and letters should be addressed to him at 34, Paradise Street, Rugby.

Photographing at a Distance.—Whereas all methods of telephotography so far suggested are designed for reproducing at the other end of the wire a ready-made photograph installed at the sending station, an interesting apparatus has recently been suggested by S. Sivelli, in *l'Elettricita*, for the purpose of reproducing at a distance the optical image of a photographic objective.

The sending apparatus consists of an ordinary photographic camera, the sensitive plate of which is replaced by a plate made up of a network of small selenium cells, insulated from one another and communicating with a constant source of electricity, the negative terminal of which is connected to earth. From each of these selenium cells there starts an insulated wire, dipping into a small mercury vessel arranged on a horizontal plane. There are thus as many mercury vessels as there are selenium cells. These vessels are arranged round the circumference of a circle, round the centre of which rotates a metal index operated by clockwork, which, with a point attached to its end, will come into contact successively with each of the mercury vessels. This index communicates with a wire connected to the receiving apparatus, and insulated from the remainder of the outfit. The apparatus is to be worked in the following manner:—

After adjusting the focus for the image to be reproduced, the circuit is closed, and the index, having been set working, will traverse, one after another, the mercury vessels corresponding to the respective selenium cells.

The electric current from the battery will traverse the selenium cell actually in communication with the metal index, and, according to the more or less considerable action of the illumination on that cell, will undergo a more or less considerable alteration in intensity. These alterations in current intensity, corresponding to the illumination of each of the selenium cells, are thus successively transmitted to the receiving station, there to be reconverted into variable light intensities.

The receiving apparatus may be of various kinds; the one suggested by Sivelli is based on the following principle:—A cylinder performing a translation and a rotation is surrounded by a sheet of white paper, at a short distance from which a style communicating with an electro-magnet is arranged. If everything be adjusted in order to eliminate any variation of current intensity as long as the luminous intensity in all the selenium cells is the same, each current closure will result in the production of a dash of more or less intensity, according as the selenium has been acted upon more or less strongly. The sheet of paper will thus be covered with a set of dashes, reproducing with greater or less approximation the optical image produced by the photographic objective.

The method thus outlined is obviously a purely hypothetical one. To produce an image at the receiving end that shall be coherent enough to be intelligible, the number of cells would have to be at least 1,000 to the square inch; and unless vastly more sensitive means than selenium cells can be devised for converting the variations of light intensity into variations of current strength, the idea seems impossible of realisation. Enormous difficulties would also be experienced in connection with the synchronising of the receiving and sending apparatus.

We, however, by no means despair of the invention of a device highly sensitive to the action of light, and we should not like to stigmatise the idea as beyond the region of ultimate possibility.

Mutual Tramway Insurance.—Some details have been given of the Mutual Tramway insurance proposals which have been formulated by the Halifax Corporation Tramways Committee, with a view to being discussed by representatives of the various owners of tramways in this country. The proposal is to form a mutual organisation, composed of municipal and limited liability company owners, each one contributing to the funds on the basis of the present premiums. It is suggested that even if only 25 tramway undertakings were to join out of the existing large number, the premiums would reach £40,000 per annum as a minimum; and this sum, it is said, should be sufficient to cover all liabilities. The suggested amalgamation of the premiums of the tramway owners would lead to the establishment of a committee of experts on tramway matters, and this committee would be able to appraise each risk at its true value, and very little reserve, if any, would be required. If there is any serious accident, or series of accidents, calling for more compensation, than the total premiums, the

amount required would be contributed *pro rata*. It is urged that the benefit of every company or corporation, and the liability as well, would be almost equal. It is also claimed that if a mutual insurance scheme is formed, the expenses of management will be small. The insurance on any single accident which may occur on the Halifax tramways is at present limited to £1,000.

Lupus Treatment at the London Hospital.—It is ten years since Queen Alexandra introduced into England the Finsen light cure for lupus by presenting to the London Hospital the first lamp. To-day there are at that hospital 11 lamps, treating 66 patients a day. In a letter to the *Times* the Hon. Sydney Holland says: "The disease has been conquered and we are within measurable distance of seeing it stamped out in its most serious form. The cost has been enormous, but surely the 'London' cannot be doing its duty if it refuses to undertake this, or any other cure, for disease simply on the ground of expense. But this, and not the closing of the beds, is what I fear most. It is really impossible to run a big hospital if it be cramped in every direction for want of money."

Institution and Lecture Notes.—Institution of Mechanical Engineers.—In a paper read before the Institution on December 20th, 1907, Dr. H. T. Ashton dealt with the manufacture and upkeep of milling cutters of high-speed steel, which has not generally been used for this purpose. Where there is plenty of work for a milling cutter, the extra cost of the high-speed steel is far outweighed by the increased life obtained, on account of the great excess of the cost of workmanship over that of material in these tools. No difficulty has been experienced in the manufacture of the cutters, which is fully described in the paper; a special machine is used for backing off the teeth, with economy in time and labour and better results than with the ordinary relieving lathe. A special machine is also used for grinding the teeth, which can be managed correctly by an unskilled man. The life of some of the cutters prepared by these methods has been extraordinary; one, for instance, has produced over 39,000 steel bodies of rifles, and is good for half as many more.

Institution of Electrical Engineers (Students' Section).—On Saturday, February 15th, at 10 a.m., there will be a visit to the works of the India-Rubber, Gutta-Percha and Telegraph Works Co. Students wishing to join the party should notify Mr. W. B. Thompson at once.

Association of Engineers-in-Charge.—Arrangements are being made for the formation of a lending library in connection with the Association. On Wednesday last Mr. Kenelm Edgcumbe read a paper on "Electrical Measuring Instruments," and to-morrow (Saturday) there will be a "social dance."

The Circular Inquiry Nuisance.—Only the other day we again referred to the annoyance caused to central station engineers by formidable lists of inquiries from their *confrères*, which courtesy impels them to answer, though the time and labour involved impose an excessive burden on their staffs. We have just received an example in the shape of a circular letter and a printed blank form which puts in the shade all previous efforts of this kind.

An Urban District Council seeks particulars of the wages and conditions of employment of every member of the staff, from the engineer himself to the stores boy, covering the office, station, outdoor and installation departments in detail. The hours worked per day and per week, the wages paid in the first, second, and third year and the maximum attained, overtime rates, Sunday work, Bank holidays and others, sick pay, extras, uniforms, and remarks—all these are asked for, and if the whole were conscientiously filled up, no fewer than 548 separate entries would be necessary.

Surely this is a little too much to ask of anyone, without payment on a liberal scale. As the engineer to whom we are indebted for the copy remarks, "The engineer of an undertaking should be capable of arriving at a proper and reasonable figure for salaries, wages and holidays, &c., without asking for such a heap of information from undertakings, a great deal of which will probably never be looked at." The concluding suggestion is, perhaps, the most galling consideration; what likelihood is there that the results of such an inquiry will ever be properly analysed, classified and digested? And seeing that no two places are alike, of what value will the data be, even if this is done?

We do not think that the engineers who issue such catechisms are always to blame; no doubt they are often instructed by their committees to obtain the information. But this only transfers the reproach to the latter, and indicates their unfitness for the control of such an undertaking as the supply of electricity. However, no doubt the nuisance will continue, despite all protests. And, after all, there is a W.P.B. in most offices.

American Railroad Difficulties.—It is reported from New York that the Federal Court has appointed Mr. F. W. Whitridge receiver of the Third Avenue Surface Railroad.

The receivership proceedings in the case of the Chicago and Milwaukee Electric Railroad are stated to have been dismissed.

Correction.—As we go to press, Mr. Charles Erith asks us to insert the following correction in his letter on the "Production of Energy from Peat," p. 47 of this issue:—In place of lines 6 to 10, read—"uses, to ascertain that the figures which Dr. Caro states to refer to 'peat, calculated free from water,' viz., non existent chemically dry peat, meant only 4,754 B.Th.U. per lb. of peat with 45 per cent. moisture as delivered to the producer."

The Snowstorm.—The heavy fall of snow in London on Tuesday night caused numerous false calls for fire-engines in the south-eastern and south-western districts, due to contacts of overhead wires. About 1½ miles of telephone wires were brought down at Hayward's Heath.

The I.M.E.A. and the Electric Supply Bill.—The Incorporated Municipal Electrical Association has sent a circular letter to various municipal bodies, enclosing a copy of the following resolution which has been adopted by the Association: "That the Association urges the Board of Trade to reintroduce the Electricity Supply Bill during the coming Session, and to exercise every means to have the same passed into law." The municipal bodies are requested to bring the matter under the notice of their local Parliamentary representatives with a view to obtaining their co-operation to bring about the desired result.

Westinghouse-Bremer Patents. — The following letter was received after our "Correspondence" columns were closed:—

"We owe you and your readers an apology for again referring to this subject, but we find Messrs. Santoni & Co. (1906), Ltd., have issued yet another statement to the Press in which they say that the object of our communication to you was misconceived.

"We recall to your readers that the sole object of our communications was to set Messrs. Santoni right on a point voluntarily and aggressively raised by themselves.

"We now say, further, that they are incorrect in stating that the proceedings taken by us against them are premature. The fact that they have given notice of appeal against the decision of the Comptroller-General does not in any way affect these proceedings, which will take their normal course.

"The British Westinghouse Electric and
"Manufacturing Co., Ltd.

"London, W.C., *January 7th*, 1908."

Appointment Vacant.—Shift engineer for the Elland U.D.C.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review posted as to their movements.

Central Station Officials.—For the post of electrical engineer at Carlisle 200 applications were received, and on Tuesday the Electricity Committee appointed Mr. O. F. Francis, of Kirkcaldy.

The Nelson Electricity Committee has advanced the salary of Mr. Nayler, assistant electrical engineer.

Members of the Burnley electricity works staff held a "smoker" at the Waverley Restaurant on Friday, January 3rd, when a presentation of a travelling trunk was made to Mr. Harry Heys, assistant clerk, who is leaving to take up the position of chief clerk at the Mansfield Electricity Works.

The Manchester Electricity Committee has recommended that Mr. S. L. Pearce, chief electrical engineer, be re-appointed for four years, the salary for the first two years to be £1,100 per annum, and for the last two years £1,200 per annum. It is arranged for Mr. Pearce to devote the whole of his time to the duties of the position, and in carrying out any electrical extensions or works in the future as may be required, the engagement to be subject to any arrangement which the Corporation may from time to time make with consulting engineers.

The Darwen Electricity Committee has increased the salary of the electrical engineer, Mr. C. Fawcett, from £250 to £275, with a further increase to £300 per year from January 1st, 1910.

Mr. Keats, acting electrical engineer of Woolwich Borough Council, has been appointed electrical engineer at a commencing salary of £325 per annum, rising by an annual increments of £25 to £400. The Council has now adopted a scheme of classification of the employés. The engineering staff has been divided into three classes as follows:—First class, with a commencing salary of £180 and a maximum of £220—two officers. Second class, commencing salary £140, maximum £150—one officer. Third class, commencing salary £90, maximum £140—six officers. A slightly different classification has been adopted with regard to the clerical staff. There will be a first and third class, each comprising one officer and a fourth class with four officers. The members of the engineering staff with their present salaries and the increase it is intended to give them on April 1st, 1908, are as follows:—F. H. Edwards, station engineer, class 1, present salary £180, increase £10; S. H. Penning, distribution engineer, class 1, present salary £180, increase £10. H. H Clare, charge engineer, class 2, present salary £140, increase £10. C. G. Eley, charge engineer, class 3, present salary £140. T. W. Bunce, charge engineer, class 3, present salary £120, increase £10. R. Berrington, charge engineer, class 3, present salary £100. C. A. Trayte, draughtsman, class 3, present salary £100, increase £10. Clerical staff, F. Kershaw, chief and committee clerk, class 1, present salary £180. J. W. Giles, assistant clerk, class 3, present salary £110, increase £7 10s. Mr. O. L. Edwards, assistant distribution engineer, having been upon the weekly staff for two years, has been placed in the third class of the engineering staff at a commencing salary of £110 per annum.

Tramway Officials.—The employés of the Doncaster Corporation tramways department held their first dinner and social on Monday last week. Mr. E. S. Rayner, electrical engineer and tramway manager, presided. About 100 workmen and their wives were present. A photograph of the party seated at dinner appears in the *Doncaster Gazette* for January 3rd.

MR. J. D. CAIRD, of Aberdeen, was on Friday appointed traffic superintendent of the Halifax Corporation tramways, at a salary of £250, rising to £350 per annum.

The Halifax Corporation tramway employés have presented four technical volumes on electricity, to MR. C. H. SPENCER, rolling stock superintendent, who recently resigned.

General.—We learn that MR. F. J. MOFFETT, B.A., A.M.I.E.E., and MR. N. B. ROSHER, A.M.I.E.E., who have until recently been engineers on the staff of Messrs. Preece & Cardew, have commenced to practise as consulting and inspecting engineers at Union Chambers, Temple Row, Birmingham. Messrs. Moffett and Rosher will devote special attention to the electrical equipment of works and factories, and also to the inspection and testing of all kinds of engineering plant and material, several leading London consultants having already appointed them as their inspecting engineers in the Midlands and Lancashire. We understand that Mr. Rosher has had an extensive experience of power work, having held, amongst other appointments, the post of resident engineer for the building and equipment of Messrs. Siemens' Dynamo Works, Stafford, and a similar post under Messrs. Preece and Cardew for the complete equipment for power and light for H.M. Dockyards at Chatham and Simon's Bay, South Africa, including the power stations at both dockyards. Mr. Moffett has had a long and varied experience of Colonial work, having held the appointment of chief electrical engineer to the Government of Lagos for several years, where he not only carried out the erection of the original station, but was responsible also for several subsequent extensions. He has also had a wide experience of central station management and in the inspection and testing of plant.

A good ring and silver-mounted pipe have been presented to MR. CALLAGHAN, late assistant engineer of the Darlington district postal telegraphs, who has been transferred to Newcastle.

It is announced that MR. S. C. HOOLEY, D.S.O., Controller of Post Office and Telegraph Stores, has retired on account of ill-health.

MR. J. W. WILKINSON, manager for North Devon for the National Telephone Co., has been appointed to take charge of the Truro district.

We understand that MR. R. H. HAYNE, A.M.I.E.E., has resigned his position of director and secretary to F. A. Glover & Co., Ltd., and is starting in the electrical contracting business on his own account, with offices in Gloucester Mansions, Cambridge Circus, W.C.

A Buenos Ayres exchange reports that MR. A. C. COOK, foreign manager to the Brush Electrical Engineering Co., Ltd., arrived in Buenos Ayres early in December.

MR. H. J. MILLS, who has for the past four years acted as outside superintending engineer and assistant contract manager for Messrs. Johnson & Phillips, Ltd., has been appointed electrical engineer to the Franco-British Exhibition, Shepherd's Bush.

Our Sydney (N.S.W.) correspondent, writing on December 3rd, says:—"MR. C. H. MERZ, who is at present in Melbourne reporting for the Victorian Government on the proposed electrification of the suburban railway system, paid a flying visit to Sydney, where he was entertained at dinner on Saturday last by the Electrical Association of New South Wales. About 25 in all were present, and after the usual loyal toast was honoured, and the health of the guest duly proposed and responded to, the musical talent was called upon and contributed to an enjoyable evening."

His Excellency M. S. A. A. LINDMAN, Minister of State, has asked to be relieved of his duties as Director-General of Telegraphs of Sweden, and this having been conceded, his Majesty has appointed M. SVEN LUDVIG HERMAN RYDIN to succeed him.

MR. CHAS. F. TRIPPE, A.M.I.E.E., manager of the arc lamp and heating department of the General Electric Co., Ltd., Queen Victoria Street, E.C., has resigned that position after 12 years' service with the company. He has opened an office at 36, Brooke Street, Holborn, E.C., where he will carry on business in electrical apparatus specialities of every description.

Obituary.—RICHARD VON FISCHER-TREUENFELD.—We learn with deep regret of the death, which occurred at Dresden on December 29th, of Herr R. von Fischer-Treuenfeld, engineer and Consul-General, aged 73 years. The deceased gentleman was an authority on military telegraphs, and at one time was Major-Commanding the Paraguayan Military Telegraph Corps. For many years he was associated with Messrs. Siemens Bros., and was also an esteemed contributor to the ELECTRICAL REVIEW. In our special issue of November 12th, 1897, in which we celebrated the 25th year of the ELECTRICAL REVIEW's existence, an article from his pen was published on "Twenty-Five Years' Progress of Military Telegraphy." His most recent work to come to our notice was his book on "Paraguay in Wort und Bild," in which, as Consul-General of that country in Saxony, he gave a great deal of interesting and valuable information relating to the industrial progress of the Paraguay Republic.

THEOPHILUS SMITH.—Many of our readers will join us in the regret which all who knew him must have felt on hearing of the death of Mr. Theophilus Smith, who expired suddenly at the pontoon of the Woolwich Ferry, on Christmas Eve, while on his way home from Messrs. Henley's Cable Works, at North Woolwich, where he had held for many years the position of chief of the submarine cable-laying department. Mr. Theophilus Smith, who was the second son of the late Mr. Thomas Lant Smith, surgeon, of Alcester, in Warwickshire, was born in that place on December 28th, 1846, and was buried there on December 31st. He was educated at Reading, and, subsequently, in 1864, became a pupil of Messrs. Bright & Clark, and was employed as their assistant on the laying of the 1869 Atlantic cable. Following that his experience in submarine cable work was extensive and varied in the positions which he occupied during his career under Mr. Latimer Clark, Sir Charles Bright, Sir Samuel Canning, and Messrs. Clark, Forde & Taylor. Later on Mr Theophilus Smith was for about 10 years, with the India-Rubber, Gutta-Percha and Telegraph Works Co., at Silvertown, where he became chief of the submarine telegraph department, leaving that company to join Mr. Sharpey Seaton, and finally joining Messrs. W. T. Henley & Co., in 1892, where, until the day of his death, he held the position of chief of the submarine cable-laying department. Among the numerous cable-laying expeditions in which Mr. Theophilus Smith took part, holding the leading position in those during the greatest portion of his career, we may mention the following:—Havana-Key West; the French Atlantic cable (on the ss. *Great Eastern*); British Indian cable; German-Norwegian cable; Aden-Zanzibar; Persian Gulf; Galveston-Vera Cruz; Cadiz-Teneriffe, Lima-Valparaiso; West Coast of Africa cables; the cables of the Cie. Francaise des Cables Telegraphique in the West Indies, and along the coasts of Dutch and French Guiana and Brazil; a cable in Japanese waters; and, lastly, a line connecting Vancouver with the mainland. Besides the cable-laying operations above detailed, and the shore-work connected with their design and manufacture, Mr. Smith had much experience in the onerous work of repairing submarine cables in many parts of the world. His last work in connection with cable-laying was in the laying of a number of telephone cables in the Strait of Georgia for the British Columbia Telephone Co. All of those who have been in any capacity associated with Mr. Theophilus Smith cannot fail to have appreciated his high professional abilities, which, coupled with his unfailing courtesy, his geniality, and kindness of heart, secured to him the high esteem of all who knew him. His equable temperament and calmness of judgment, under the conditions of a work which, even at the best, is one of continuous strain and anxiety, were not the least salient among his many excellent qualities of heart and mind. Although aware for the last 10 years that he might be suddenly called away, at any moment, this knowledge in no way affected his cheerfulness of demeanour, nor did it interfere with the execution of his work. Of him it may, indeed, be said "he died in harness." In venturing to offer our respectful expressions of sympathy to Mrs. Smith and to the other members of the family on their loss, we feel assured that we are fully associated with the late Mr. Theophilus Smith's numerous friends; enemies he had none.

CITY NOTES.

Stratford-on-Avon Electricity Co., Ltd.

THE first annual meeting was held on December 23rd, at the offices at Stratford-on-Avon. The revenue account for two months then presented, showed a balance of £34 odd carried forward at June 30th last.

MR. G. M. BIRD, who presided, said that since that date the business had been growing every week. Everything was complete, the mains had been laid and the engines and plant installed, and they were equal to any demand that might arise. Their contract (£7,600) was only exceeded by £60 by way of extras, which showed considerable foresight on the part of Mr. Falcke, their engineer, in arranging the specifications. They had now 50 consumers. They were themselves carrying out wiring and fitting work, and were also anxious to develop heating and cooking. A popular exhibition might be organised in the spring. He was not going to be optimistic and promise a dividend next year, but sooner or later a steady dividend would accrue.

The report was adopted.

MR. S. PATERSON, the largest shareholder in the company, was elected to a seat on the board.

It will be remembered that the whole contract of the supply, and erection of the power station plant, supplies and cables, &c., was carried out by Messrs. Johnson & Phillips, Ltd.

South London Electric Supply Corporation, Ltd.—

At an extraordinary general meeting, held on Tuesday at Cannon Street Hotel, E.C., resolutions, which were passed on 20th ult., were confirmed reducing the existing nominal capital of the company from the sum of £325,000 to the sum of £260,000, thus reducing the capital of the company by £65,000, by the alteration of the 65,000 shares of £5 each, now forming the capital of the company, into 65,000 shares of £4 each. From remarks made by the chairman (Mr. J. Atherton), it appeared that the loss incurred in dismantling the destructor was not anything like £65,000; the balance was made up by certain obsolete plant. The destructor while at work made some profit and destroyed many thousand tons of refuse, but there had been years of litigation about it, and they had now got rid of it. They had utilised a large amount of the material, and the land cleared by its removal was being devoted to other purposes.

France.—The balance sheet of La Compagnie Générale d'Electricité, of Paris, for the last financial year, shows a profit of £164,404, as compared with £73,056 in the preceding 12 months. A dividend of 6 per cent. is being declared.

Chili Telephone Co., Ltd.—The directors have declared the usual interim dividend for the half-year ended September 30th last, at the rate of 6 per cent. per annum, free of income-tax.

MARKET QUOTATIONS

Wednesday, January 8th.

CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	88/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£16	..
a Copper Sulphate	per ton	£23 10	..
a Lead, Nitrate	per ton	£31	..
a ,, White Sugar	per ton	£20	£2 dec.
a ,, Peroxide	per ton	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a ,, Chlorate	per lb.	9½d.	..
a ,, Perchlorate	per lb.	9d.	..
a Potassium Cyanide	per lb.	7d.	..
a Shellac	per cwt.	125/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
a ,, Cyanide (basis 100 %)	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£108	..
b ,, Wire, in ton lots	per ton	£150	..
b ,, Sheet, in ton lots	per ton	£145	..
v Babbitt's metal ingots	per ton	£50 to £125	dec.
c Brass (rolled metal 2" to 12") basis	per lb.	7⅞d.	¼d. inc.
c ,, Tube (brazed)	per lb.	9¼d.	..
c ,, ,, (solid drawn)	per lb.	8¼d.	..
c ,, Wire, basis	per lb.	8d.	¼d. inc.
c Copper Tubes (brazed)	per lb.	10d.	..
c ,, ,, (solid drawn)	per lb.	10d.	..
g Copper Bars (best selected)	per ton	£78	..
g Copper Sheet	per ton	£78	..
g ,, Rod	per ton	£78	..
e ,, (Electrolytic) Bars	per ton	£65	£1 inc.
e ,, ,, Sheets	per ton	£82	£1 inc.
e ,, ,, Rod	per ton	£71	£1 inc.
e ,, ,, H.C. Wire	per lb.	8¼d.	¼d. inc.
f Ebonite Rod	per lb.	8/8	..
f ,, Sheet	per lb.	8/-	..
n German Silver Wire	per lb.	1/6½	..
h Gutta-percha, fine	per lb.	5/6 to 6/6	..
h India-rubber, Para fine	per lb.	3/4½ to 3/5	dec.
i Iron Pig (Cleveland warrants)	per ton	48/7½	1/1½ dec.
l ,, Wire, galv. No. 8, P.O. qual.	per ton	£16	..
g Lead, English Ingot	per ton	£14 10 to £14 15	..
g ,, ,, Sheet	per ton	£15 14 to £15 19	..
m Manganin Wire No. 26	per lb.	8/-	..
g Mercury	per bot.	£8 5	..
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large	per lb.	4/6 to 6/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/2	..
p ,, rolled bars & rods	per lb.	1/2 to 1/3	..
p ,, strip & sheet	per lb.	1/2½ to 1/5	..
o Platinum	per oz.	110/-	..
e Silicium Bronze Wire	per lb.	10d.	..
r Steel, Magnet, in bars		£60	..
q Tin, Block (English)	per ton	£124 to £125	£11 10 dec.
n ,, Wire, Nos. 1 to 16	per lb.	1/9½	½d. dec.
p White Anti-friction Metals—			
"White Ant" brand	per ton	£40 to £60	..
k Zinc, Sh's (Vieille Montagne brd.)	per ton	£25	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.
r W. F. Dennis & Co.

Geneva Tramways Co. (1906).—According to the *Times*, the report for the period from December 17th, 1906, to September 30th, 1907, states that the results of working the Compagnie Genevoise des Tramways Electriques (the Swiss company) for the year ended December 31st, 1906, show a gross profit of 562,141 fr., plus 227,652 fr. brought forward. A dividend of 1½ per cent. has been paid, leaving 310,467 fr. to be carried forward.

Moscow.—TRAMWAY LOAN.—It is reported that the municipal loan for ten million roubles for tramways and other purposes, has been purchased by an Anglo-American syndicate.

Simplex Conduits, Ltd.—Dividend warrants have been posted for the usual 6 per cent. dividend on this company's preference shares for the half-year ending December 31st, 1907.

STOCKS AND SHARES.

Tuesday Evening.

NEW YEAR markets in the Stock Exchange are so far proceeding upon satisfactory lines. Of the few canards which still have to do duty, the most noteworthy is the alleged tension between Japan and the United States. Nobody takes this, however, with any seriousness on our side of the Channel, although it appears to have received a certain credence in Paris. Money is becoming cheaper, and with that, the chief trouble of the investment sections begins to evaporate.

Weird stories, varied day by day, are circulated with regard to the possibility of working agreements being arrived at between this, that, and the other railway company. The District has been mated with several concerns, and the Metropolitan partnered with three or four others. Absurd as some of the rumours are—for instance, it was declared that the Great Eastern would absorb the District—they have had their effect upon prices. Metropolitan Ordinary stock has been run up several points to 44, while Districts, too, improved, at 11. Sharp rises have occurred in the prior-charge stocks of both companies, and complementary to this advance came a little demand for East London Preferences.

Central London Preferred rose a point, the Ordinary and the Deferred 2 each, and the movement is said to have been assisted by the strike on the London Road-Car system. City and South London Ordinary has hardened, and even Great Northern and City Preferred at £2 are 5s. better. Home Railway stocks as a whole continue to be active and buoyant, although a large amount of the business is clearly due to professional speculators rather than the investing public.

In the speculative divisions, a good deal of interest is taken in the forthcoming dividend upon Anglo-American Telegraph Deferred stock, due to be declared on Friday, January 17th. A year ago it was 35s. per cent., and the market estimates now range from 18s. to £1 per cent. All the company's three stocks are better, and the Deferred is nearly 2 points up within the past fortnight.

Amazon Telegraph shares are lower at 2½, but, on the whole, the Telegraph section is good, sharing in the better tone of investment stocks generally. Direct United States Cable shares hardened in sympathy with Anglo-Americans. The Eastern group keeps very steady, but without much quotable movement, and Globe Telegraph and Trust Ordinary are picking up part of their loss. The Mackay stocks are hard at their advanced levels.

Marconi shares dropped to 11s. 3d. National Telephones are good, and show two or three rises in their issues. Telephone descriptions show no changes beyond these.

That there are a few hardy spirits left who will buy Electricity Supply shares is shown by improvements in the Preference shares of the Charing Cross, South London, Metropolitan and Westminster Companies. In the case of the last two, the advances are somewhat in the nature of replacement of recent losses, but evidently the declines attracted notice, and buyers. The Charing Cross Company is doing well, as was pointed out here last month, when the cheapness of the Preference shares received attention. The solitary change in the catalogue of Debenture stocks is a point rise in City of London Seconds, but several of the Ordinary shares are strong. Notting Hill, Westminster and a few provincial Ordinary shares show advances.

Further evidence of investment appetite is to be seen in the 2 point rise in British Aluminium 5½ per cent. Loch Leven Debentures. British Columbia Electric Railway 5 per cent. Preference added a similar amount. On the other hand, British Electric Traction Second Debenture fell a point, and Brush Second Debenture lost 2. In both cases the margin behind their securities can hardly, perhaps, be described as ample. Westinghouse Debenture is quoted 2 lower at 43 middle.

Argentine Tramway shares have hardened, and Dublin United rose 10s., while London United Tramways Debenture stock recovered its last week's fall. Of the American bonds, Mexico Trams 5 per cent. Gold Bonds change hands with freedom between 82 to 83. Havana Electric 5 per cent. bonds have been done at 85¼, and for Sao Paulo 5 per cent. First Debenture a buyer early this week paid 93.

The feature in the Miscellaneous division is the improvement in British Aluminium Ordinary and "A" Preference shares, for both of which there is a quiet demand after the recent depression. Henley's Preference came to market, the price yielding ⅛ upon a small selling order, and Crompton's at 1⅛ show a slight loss.

Stock Exchange Notice.—The Committee have ordered the undermentioned securities to be quoted in the Official List: Underground Electric Railways Co. of London, Ltd., £1,100,000 deposit receipts for 5 per cent. profit-sharing secured notes.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Dec. 31st.	Closing Quotations Jan. 7th.	Business done week ended Jan. 7th, 1908. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	2½ — 3½	2 — 3	..	..	— ½	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	84 — 87 xd	84 — 87	..	..	..	5 14 11
$131,551,400	American Telephone & Telegraph, Cap. Stock	$100	7¾%	7¾%	7¾%	8 %	105 —108	107 —110	107½	106½	+2	7 5 6
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	88 — 90	86 — 88 xd	..	..	—2	4 10 11
660,660	Anglo-American Telegraph	Stock	61s.	2¾%	3½%	3¾%	55 — 58	57 — 60	..	..	+2	6 9 2
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5½%	6 %	6 %	99 — 101	100 —102	101¾	99½	+1	5 17 9
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	¼	1¾%	16 — 16½	16⅝ — 17⅛	17⅛	15⅛	+ ¾	10 2 11
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	Stock	7 %	8 %	8 %	8 %	6½ — 7½	6½ — 7½	..	..	..	5 10 4
2,097,680	Commercial Cable Sting. 500 year 4 % Deb. Sk. Red.	10	4 %	4 %	4 %	4 %	80 — 84 xd	80 — 84	80	..	..	4 15 3
16,000	Cuba Telegraph	5	7 %	8 %	8 %	8 %	6 — 7	6 — 7	..	..	..	7 2 10
6,000	Do. 10 % Pref.	10	0 %	5 %	10 %	10 %	15 — 16	15 — 16	..	..	..	6 5 0
12,981	Direct Spanish Telegraph, Ord.	10	15 %	10 %	10 %	10 %	3½ — 3¾	3½ — 3¾	..	..	..	5 14 3
6,000	Do. do. 10 % Cum. Pref.	5	4 %	4 %	4 %	4 %	8¼ — 8½	8¼ — 8½	..	..	..	5 14 3
30,000	Do. do. 4½ % Debs.	50	10 %	10 %	10 %	10 %	98 —101	97 —100 xd	100½	98	+ ½	9 0 0
60,710	Direct United States Cable	20	3 %	3½%	4½%	4½%	13⅜ — 13⅞	13½ — 14	13⅞	13⅜	+ ⅛	6 12 2
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	130 —135	130 —135	133	133½	..	5 3 8
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	83 — 86	83 — 86	..	..	..	4 1 5
1,896,706	Do. 4 % Mort. Deb. Stock. Red.	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	100½	99½	..	3 18 6
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	128 — 127	128— 127	129	125	..	5 8 9
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	99½—102½	99½—102½	..	..	..	3 18 1
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	3 19 3
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98½—100½	99 —101	..	..	..	3 19 8
181,127	Globe Telegraph and Trust	10	5½%	5½%	5½%	5½%	9½— 10	9½— 10	9 13/16	9 5/16	— ⅛	15 17 0
181,127	Do. do. 6 % Pref.	10	5 %	5 %	6 %	6 %	12½— 13	12⅝— 13⅛	13⅛	12⅝	..	5 10 0
150,000	Great Northern Telegraph, of Copenhagen	10	6 %	6 %	6 %	6 %	30½— 32½	30½— 32½	31½	30½	..	4 10 7
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101 xd	..	..	..	6 3 1
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	52 — 55	52 — 55	52	..	..	4 9 1
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3½%	53 — 58	53 — 58	..	..	..	6 5 0
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	60 — 65	60 — 65	..	..	..	6 0 8
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅜— ⅝	⅜— ⅝	12/9	12/3	— 1/16	6 3 1
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	6 %	1 5/16— 1 7/16	1 5/16— 1 7/16	..	..	..	Nil
86,492	Do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	1 3/16— 1 5/16	1 3/16— 1 5/16	..	..	..	4 14 1
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	⅞— 1	⅞— 1	..	..	..	5 0 0
2,225,000	Do. do. Def. Stock	100	5 %	6 %	6 %	6 %	109 —111	110 —112	111	110½	+1	5 7 2
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	107 —109	107½—109½	108⅝	107½	+ ½	4 11 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½— 12½	10⅝— 12⅝	12⅝	11⅝	..	4 16 0
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	10	5 %	5 %	5 %	5 %	10 — 12	10 — 12	..	..	..	4 3 4
2,000,000	Do. do. 5 % Mort. Deb. Stock Red.	Stock	3½%	3½%	3½%	3½%	5⅝— 5¾	5⅝— 5¾	5⅞	5⅝	..	4 11 11
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 98 xd	96 — 98	99⅛	96½	..	3 11 5
179,318	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6½%	6½%	7 %	7 %	98 —100 xd	98 —100	..	..	..	4 0 0
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1⅛— 1⅜	1⅛— 1⅜	..	..	..	5 17 11
100,000	Do. do. do. 4 % Red. Deb. Stock	100	..	..	4 %	4 %	1⅛— 1 5/16	1 1/16— 1 3/16	21/8	..	..	5 1 1
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	90 — 93	90 — 93	90	..	..	4 6 0
100,000	Reuter's	8	5 %	5 %	5 %	5 %	90 — 98	96 —100	..	..	..	4 0 0
11,839	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	97 —100	7 — 8	7⅞	..	..	5 0 0
60,000	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	7 — 8	98 —101	..	..	..	4 9 1
8,167	United River Plate Telephone	5	8 %	8 %	8 %	8 %	98 —101	124 —127	..	..	..	4 14 6
80,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	124 —127	124 —127	6⅛	..	..	5 14 3
40,000	West African Telegraph, Shares	10	4 %	4½%	4½%	4½%	6¾— 7 xd	6½— 7	6 13/16	..	..	4 15 3
15,609	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	Nil	2½%	4½— 5½ xd	4½— 5½	..	..	..	3 16 9
30,008	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	10 — 10⅝	10 — 10⅝	22/6	..	..	3 12 9
150,000	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	7 %	1⅜— 1⅝	1⅜— 1⅝	..	..	..	4 4 3
207,980	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 98 xd	95 — 98 xd	12⅛	12 1/16	..	5 6 8
800,000	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	12⅜— 13⅛	12⅜— 13⅛	..	..	..	4 0 0
88,321	Do. do. 6 % Cum. 1st Pref.	10	7 %	6 %	5 %	8 %	97 —100	97 —100	..	..	..	Nil
34,563	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	⅞— 1	⅞— 1	..	..	..	10 6 6
4,669	Do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	5 %	7⅛— 7⅜	7⅛— 7⅜	..	..	..	Nil
80,000							7⅛— 7⅝	7⅛— 7⅝	..	..	..	4 19 0
							98 —101	98 —101 xd	..	..	..	

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,006 to 580,097	5	..	8 %	8 %	8 %	7½— 8½	7½— 8½	8	7⅞	..	4 17 0
260,007	Do. 6 % Cum. Prefs., 1 to 260,007	5	5½%	5½%	5½%	5½%	5¾— 6 xd	5 13/16— 6 7/16	6 7/16	5 15/16	..	4 8 0
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	125 —128 xd	125 —128	..	..	..	4 13 9
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock	100	5 %	5 %	5 %	5 %	101 —104	101 —104 xd	103½	..	..	4 16 2
880,000	Babcock & Wilcox, 1 to 880,000	1	17 %	20 %	20 %	20 %	3½— 3¾	3⅜— 3½	73/6	..	..	5 6 8
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000	1	6 %	6 %	6 %	6 %	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	+ 1/16	5 16 10
35,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	7 %	4¼— 4½	4⅛— 4⅜	..	..	..	7 15 7
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	4¾— 5	4½— 5	98/9	..	+ 1/16	7 0 0
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	4¼— 4½	4¼— 5½	..	..	..	5 14 3
90,000	Do. do. 4 % Funding Certs.	5	5 %	4 %	5 %	5 %	3¾— 4¼	3¾— 4¼	101	100½	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	5 %	5 %	5½%	100 —103	100 —103	..	..	+2	5 13 5
300,000	Do. do. 5½ % Loch Leven Debs.	100	6 %	6 %	6 %	6 %	95 — 98	97 —100	97½	..	..	5 10 0
400,000	Do. do. 5½ % Loch Leven Def. Ord. Stock	100	5 %	5 %	5 %	5 %	124 —127	124 —127	127	..	..	4 10 3
300,000	British Columbia E. Rail Def. Ord. Stock	100	5 %	5 %	5 %	5 %	105 —109	105 —109	..	..	+2	4 11 9
300,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	99 —103	101 —105	..	..	..	4 15 3
800,000	Do. 5 % Cum. Perp. Pref. Stock	40	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
288,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	10	6 %	6 %	3 %	Nil	1½— 1⅝	1½— 1⅝	31/8	..	..	Nil
138,801	British Electric Traction	10	6 %	6 %	6 %	6 %	5 — 5½	5 — 5⅛	5⅝	5⅛	..	10 18 2
161,437	Do. do. 6 % Cum. Pref.	Stock	5 %	5 %	5 %	5 %	90 — 93	90 — 93	92	..	-1	5 7 6
1,448,653	Do. do. 5 % Perp. Deb. Stock	100	..	4½%	4½%	4½%	70 — 75	69 — 74	70	..	..	6 1 7
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	5	8 %	8 %	8 %	8 %	6¼— 6⅝	6½— 6⅝	6⅝	6½	..	7 8 2
100,000	British Insulated and Helsby Cables	5	6 %	6 %	6 %	6 %	10 %	5⅛— 6⅛	..	..	..	4 18 0
100,000	Do. do. 6 % Cum. Pref.	6	6 %	6 %	6 %	6 %	6¼— 6⅝	100 —103	..	..	..	4 7 5
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	100 —103	85 — 89	..	..	..	4 18 11
212,000	Do. do. 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	4½%	85 — 89	..	..	..	..	
400,000	British Thomson-Houston 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	4½%	85 — 89	..	..	..	..	Nil
1,016,858	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	Nil	½— 1½	½— 1⅛	..	..	..	
50,000	Do. do. 4 % Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	40 — 50 xd	38 — 48	41	..	—2	8 6 8
50,000	Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	Nil	1 5/16— 1 7/16	1 5/16— 1 7/16	..	..	..	Nil
105,731	Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
150,000	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	2½%	Nil	0— ½	0 — ½	..	..	..	Nil
125,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	½— ¾	½— ¾	..	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	4½%	83 — 86	83 — 86	..	..	—1	5 4 8
	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	65 — 68 xd	63 — 68	..	..	+ 1/16	6 12 4
	Do. do. 4½ % Perp. 2nd Deb. Stock	5	3 %	4 %	3 %	3 %	4⅛— 4⅜	4 1/16— 4 3/16	..	..	..	8 4 0
	Buenos Ayres & Belgrano, 1 to 100,000	5	6 %	6 %	6 %	6 %	4⅜— 5⅛	4½— 5⅛	..	..	..	5 14 3
	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅜— 5⅛	4½— 5⅛	..	..	..	5 14 3
	Do. do. "B" do., 1 to 27,500	5	6 %	5 %	5 %	5 %	105 —115 xd	105 —115 xd	..	..	..	4 6 11
	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	101 —104 xd	101 —104 xd	..	..	..	4 16 2
	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	8 %	8 %	6⅜— 6⅝	6⅜— 6⅝	..	..	..	5 16 4
	Calcutta Trams, 1 to 137,610	5	6 %	8 %	5 %	5 %	4⅝— 5⅛ xd	4⅝— 5⅛xd	..	..	..	4 13 0
	Do. 5 % Cum. Pref., Nos. 1 to 29,380	5	..	..	..	..	99 —103	99 —103 xd	..	..	..	4 7 5
	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	9¾— 10¼	9½— 10½	..	..	..	7 6 4
	Callender's Cable Construction shares	5	12½%	12½%	15 %	15 %	5¼— 5½	5¼— 5½	..	..	..	4 6 11
	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	104 —106 xd	104 —106	..	..	..	4 4 11
	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	⅛— ⅜	⅛— ⅜	..	..	..	Nil
	Cape E Trams., 1 to 491,222	10	5 %	5 %	Nil	Nil	1⅛— 1⅜	1¼— 1⅜	26/6	25/3	+ 1/2	5 18 4
	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	101 —104	10⅛—104	101½	101	+ 2	4 6 7
	Do. do. 4½ % 1st Mort. Deb. Stock	1	4 %	4 %	6 %	8 %	83 — 86	65 — 68	67⅛	65	..	5 17 8
	Central London Railway, Ord. Stock	100	4½%	4½%	4½%	4½%	83 — 86	84 — 86	8⅜	..	+ 1	4 13 0
	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	42 — 45	44 — 47	..	..	+ 2	4 10 1
	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	42 — 45	45 — 47	48	44½	+ 2	4 10 5
	City and South London Railway	Stock	2¾%	2¾%	2¾%	2¾%	49 — 45					

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Dec. 31st.	Closing Quotations Jan. 7th.	Business done week ended Jan. 7th, 1908.		Rise + or Fall —	Present Yield per cent.
		*	1903.	1904.	1905.	1906.			Highest.	Lowest.		£ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	8	2½%	2½%	2½%	5 %	1⅝— 1¹³/₁₆	1⅝— 1¾	..	..	—1/16	8 13 11
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	94 — 97 xd	..	..	—2	5 3 1
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	10 %	1⅛— 1⅜	1⅛— 1⅜	..	..	..	7 5 5
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	%	6 %	6 %	6 %	1 — 1¼	1 — 1¼	..	..	..	4 16 0
294,150	Do. dc. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	99 —102 xd	99 —102	..	..	..	4 8 3
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½%	6 %	6%	6 %	12⅛— 13½	13 — 14	..	..	+ ⅛	4 5 9
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12½— 13½	12½— 13½	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	Nil	2½%	4½%	4½%	⅞— 1⅛	⅞— 1⅛	..	..	..	11 7 6
17,189	Do. "A" shares, 01—017,189	5	Nil	2½%	4½%	4½%	1½— 2⅛	1½— 2⅛	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	78 — 81 xd	78 — 81	..	..	..	4 18 9
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	87 — 90	87 — 90	..	..	..	5 11 1
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	Nil	⅛— ⅜	⅛— ⅜	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,290	2	7 %	7 %	7 %	Nil	⅝— 1⅛	⅝— 1⅛	..	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	7½— 8¼ xd	7½— 8¼	..	..	..	6 1 3
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..	4 19 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	1½— 2	1⅞— 2⅛	..	..	+ ⅛	17 15 6
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½— 10⅞	10½— 10⅞	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	10½— 11⅛	10½— 11⅛	11⅜	11	..	6 10 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5⅛	4⅞— 5⅛	97/6	..	— ⅛	3 19 1
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	104½—106½	104½—106⅜	..	..	..	4 4 6
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10%	5 %	10%	10 %	14½— 15½ xd	14⅜— 15½	..	..	..	6 9 0
37,500	†Liverpool Overhead Railway, Ord.	10	12½	12½	Nil	Nil	1⅜— 1⅝	1½— 1⅝	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	8 %	8 %	6¼— 6⅝	6¼— 6⅝	..	..	..	4 8 11
399,930	Do. do. 50,008 to 100,000	10	8 %	6 %	8 %	8 %	6¼— 6⅝	6¼— 6⅝	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7½— 8⅛ xd	7½— 8⅛	..	..	..	6 1 3
1,931,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	79 — 83 xd	80 — 84	80	..	+1	4 15 3
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	1/32— 3/32	1/32— 3/32	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	13/32— 15/32	13/32— 1/2	16/9	..	..	5 6 8
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	91 — 94	91 — 94 xd	..	..	..	4 15 9
245,500	Potteries E. Tre.	1	5 %	5 %	4 %	4 %	3/32— 5/32	3/32— 5/32	..	..	..	7 2 3
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/32— 5/32	3/32— 5/32	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 13 9
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	28½— 30½	28½— 30½	..	..	..	5 7 2
150,000£	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100 —103	99 —102 xd	..	..	—1	3 18 5
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	35 — 39	35 — 39	..	..	..	13 3 2
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	⅜— 1½	⅜— 1½	..	..	..	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3⅛— 3⅝	3⅛— 3⅝	..	..	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	72 — 77	72 — 77	75	..	..	5 1 3

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P,. 1 to 14,000	5	5 %	5½%	5½%	5½%	4⅜— 5⅛	4⅜— 5⅛	..	..	..	5 7 4
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	7 — 8	7 — 8	7⅞	7⅞	..	6 5 0
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	7⅞	..	..	4 7 6
836,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3⅞— 4⅛	3⅞— 4⅛	..	..	..	5 2 10
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3⅞— 4⅛	4 — 4⅛	87/6	..	+ ⅛	5 0 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅞— 4⅛	4 — ⅛ d	82/6	..	..	5 5 11
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 9e	95 — 98	..	..	..	4 1 8
49,486	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	4½%	3⅞— 4⅛	3⅞— 4⅛	..	..	..	5 5 11
175,000£	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100 —103 xd	100 —103	..	..	..	4 7 5
70,595	City of Londo Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9⅛— 10⅛	9⅝— 10⅝	10⅝	10⅛	+ ⅛	5 11 8
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11 — 12	11 — 12	11 1/16	10 1/16	..	5 0 0
400,000£	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	120 —123 xd	120 —123 xd	122	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	93 — 96 xd	95 — 98	94½	..	..	4 13 9
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	3½— 4¼	3½— 4¼	..	..	..	4 14 1
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4⅜— 4⅞	4⅜— 4⅞	..	..	..	5 2 7
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	6½— 7⅛	6½— 7⅛	..	..	..	6 13 4
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10½— 11	10⅞— 11	10⅞	..	..	5 9 1
400,000£	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	103 —106 xd	103 —106	..	..	..	4 4 11
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	3/32— 5/32	3/32— 5/32	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	3/32— 1¼	3/32— 1¼	..	..	..	10 0 0
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	70 — 80	70 — 80	..	..	..	5 12 6
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4½— 5	4⅝— 5	..	..	..	5 10 0
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	4⅝— 5⅛	4⅝— 5⅛	..	..	..	4 18 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6⅝— 6⅞	6⅝— 6⅞	..	..	..	6 10 11
21,000	Kensington and Knightsbridge Electric Ord.	5	12½	12 %	10 %	10 %	8 — 9	8 — 9	..	..	..	5 11 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	95 — 98	96 — 99	..	..	+1	4 0 10
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1⅛— 1⅜	1⅛— 1⅜	..	..	..	6 16 2
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4 — 4⅛	4⅛— 4⅜	..	..	+ ⅛	6 6 4
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	87 — 91	87 — 91	..	..	..	4 18 11
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8⅜%	10 %	10 %	8 %	5⅜— 5⅞	5⅛— 6	..	..	+ ⅛	6 13 4
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜— 4⅝ xd	4⅜— 5⅛	..	98/9	+ ⅛	4 5 9
220,000£	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	100 —104 xd	100 —104	..	..	..	4 6 7
250,000£	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	85 — 90 xd	85 — 90	..	..	..	3 17 9
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	8 %	6¼— 6⅝	6¼— 6⅝	..	..	..	5 18 6
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	6 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	10½— 11½	11 — 12	..	..	+ ⅛	6 5 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6½%	7 %	7 %	7 %	5⅛— 5	5⅛— 6	5 1/16	..	..	5 16 8
60,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	96 — 97	95 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	7⅜— 8⅛	7⅛— 8⅛	7 1/16	..	..	6 1 8
20,000	Do. do. 7 % Pref. 20,061 to 40,060	5	7 %	7 %	7 %	7 %	6⅞— 7⅛	6⅞— 7⅛	..	..	..	4 13 4
150,000£	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	85 — 90	85 — 90 xd	..	..	..	3 17 9
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	⅛— 1⅛	⅛— 1⅛	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	71 — 75	71 — 75	..	..	..	5 4 4
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	2⅛— 3	2⅛— 3	52/6	..	..	5 0 0
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	3/32— 5/32	3/32— 5/32	..	..	..	3 6 8
117,868	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 — 1 1/16	1 — 1 1/16	25/-	..	+ 1/16	5 12 0
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅛— 2⅛	1⅛— 2⅛	..	..	..	12 10 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1⅛— 2⅛	1⅛— 2⅛	..	..	..	8 13 11
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	90 — 93	90 — 93	..	..	..	4 16 9
110,000	Westminster Electric Supply, Ord.	5	18½%	14 %	18 %	12 %	7⅜— 8⅛	8 — 9	8 7/16	..	+ ⅛	6 13 4
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	4⅛— 5 xd	4⅜— 5⅛	5	..	+ ⅛	4 5 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 6 per cent. January 2nd, 1908.

THE CANAL INQUIRY.—III.

[COMMUNICATED.]

It will probably be of interest to review briefly recent attempts to adapt electrical traction to canals. The effective pull on the tow rope varies considerably with the character of the track on which the tractor works. Without rails, and with tractor working on the ordinary tow-path, the effective pull varied from 40 to 50 per cent. of the weight of the tractor. Working on a single rail it was from 58 to 64 per cent. of the weight, on a double line of smooth rails it was about 65 per cent., while in a special case where the adhesion was assisted by means of springs, and the tractor worked on a mono-rail system, the effective pull rose as high as 81 per cent. of the tractor weight. The French experiments on the Douai Canal demonstrate that the expenditure of power in propelling a tractor when working over an ordinary tow-path seems to be about six times as great as when the tractor moves over rails, while the upkeep is lower when rails are used than with the ordinary surface, so that there can be little doubt that the more economical plan from every point of view would be to equip the tow-paths with rails on the mono-rail system, and use a special tractor whose adhesion was supplemented by a device of the nature of the proportional adhesion tractor successfully adopted on the Erie Canal in 1905. In the following table the various essays of electric traction are divided up in accordance with the nature of the permanent way over which the tractor worked :—

Date.	Nature of pathway.	Country.	Name of canal.	System of tractor.	Power. H.P.	Efficiency of pull on tow rope.
1895	Tow-path surface	France	Burgundy Canal	Galliot tricycle	6	40
1900	Do.	Do.	Deule do.	Do.	10	43
1899	Do.	Belgium	Charleroi Canal	Gérard quadri-cycle	7	50
1906	Do.	France	Douai Canal	Denèfle cycle	13	42
1902	Two smooth rails	Belgium	Charleroi Canal	Gérard tractor	12	65
1904	Do.	France	Deule and Scarpe	Tractor	20	67
1904	Do.	Germany	Teltow Canal	Siemens traveller	15	65
1906	Do.	France	Douai Canal	Denèfle cycle	2	50
1896	Mono-rail (rack)	Germany	Finow Canal	Siemens tractor	2	58
1904	Do.	U.S.A.	Erie Canal	Wood tractor	70	64
1905	Do.	Do.	Do.	Proportional adhesion tractor	35	81

The cost of the electrical equipment on the Erie Canal, carried out by the General Electric Co., seems to have been practically the same as the equipment on the Douai Canal in France, amounting to about £1,250 a mile. In the latter case, suitable electric locomotives of about 40 H.P. cost £320 each. The German experiment on the Teltow Canal is being very carefully supervised and tested by the municipality which is responsible for the undertaking, with customary German thoroughness, and the published results when available will form interesting reading.

Like the postscript to a letter, the appendices to the evidence taken by the Railway Commissioners form by far the most valuable portion of the published volume of minutes, and they contain an enormous amount of information of a miscellaneous character connected with canals as they are at the present time in the British Isles, to which certain data connected with the Continental canals in France, Belgium, and Germany, has been added. The only drawback to this information is its somewhat diffuse and undigested character—and its obvious omissions. Among these may be mentioned the absence of data from the railway point of view of the comparative unit costs of haulage by canal and by railway, and especially an authoritative statement of the railway side of the comparison. One particular witness, the general manager of the North Staffordshire Railway and of the Trent and Mersey Navigation, whose evidence as an expert in both methods of traction was most valuable, notwithstanding the evident bias of his original canal training, seems to have made out a very poor case for the canal side under existing conditions against an over-favourable one for the railway side. Irrespective of the tolls chargeable for wayleaves, the capital cost of equipping the canal service varied from about twice in the case of horse traction to five times for tug traction, that of the railway service; while the cost of working varied from a little over 10 times in the case of horse-haulage to seven times with tug haulage, the normal cost of railway working. It must be remarked that this comparison is instituted under most unfavourable conditions for the canal case, as it is between canals of the narrow gauge and small locks characteristic of Staffordshire, and a first-class railway like the London and North-Western or the Great Western. The improvement in the cost of tug haulage is principally due to the fact that with this system the barges would be worked in trains of three with a proportionate diminution in the number of men employed. A reduction in the staff of men of about 37 per cent. produced a saving of some 34 per cent. in the cost of working, so that it would be reasonable to infer that, with a further reduction down to something like the railway level of men employed for a similar service on railways, the canal cost could be reduced to something like the railway cost, if not below it. This reduction could not, however, be effected without working the 25-ton barges in trains of 16 coupled barges, or without the preliminary replacement of the old locks by electric inclines and the substitution of mono-rail electric traction on the tow-paths for both horse or tug haulage. By working at an average of 10 miles per hour instead of some 2½ miles, the canal transit could be reduced, in the example worked out by Mr. Phillips, to 2½ days instead of six days in the case of the coal traffic from Staffordshire to London by canal under improved conditions, with a further proportionate reduction both in the cost of working and the cost of barge equipment, which would again reduce the comparative cost in this case, and probably place the canal cost under that of the railway in proportion of something like 3 to 5. The whole question seems under these circumstances to resolve itself into the question of the capital cost of the improved canals, rather than the cost of working. It would be most hazardous, however, to attempt an estimate of the average capital cost where the variety in the circumstances and the cost of our heterogeneous collection of canals is so great as it is.

A rough idea of what the cost might amount to, at a minimum figure and under the most favourable circumstances, of the rehabilitation of an average 100 miles of narrow gauge canal (*i.e.*, one worked by 25 to 30-ton barges), might be the following—it being understood that no attempt is made to alter the gauge, and exclusive of barge equipment and cost of generating stations :—

Nominal cost of 100 miles of unimproved narrow-gauge canal, at £3,500 a mile	£350,000
Cost of providing a second towing-path, comprising various minor improvements and alterations to existing towing-path, bridges, &c., including additional land, at £1,000 a mile	100,000
Cost of, say, 20 electric inclines, at £15,000 each ...	300,000
Cost of double line of mono-rail track and electric equipment, exclusive of locomotives, at £2,500 a mile	250,000
Say 200 electric locomotives, at £1,000	200,000
Unforeseen	50,000
= £12,500 per mile Total	£1,250,000

If the extra purchase cost involved in expropriation for public purposes and the accessory works, such as additional barge equipment of improved character and proportion of cost of generating station, were added, this £12,500 would very readily be increased by at least 50 per cent., and a more probable total would be £20,000 per mile, which could easily run up to the total cost of some £60,000,000, at which we previously estimated it, from a totally different standpoint.

It is abundantly evident, not only by the terms of the reference, but also by the character of the questions put to witnesses and the tenor of the information which has been so far elicited and published, that the Canal Commission was appointed for a definite purpose other than gathering

together data concerning the past and present of our canals. This specific purpose was that of blessing a scheme by which the powers-that-be hoped to appease the growing popular clamour for the ownership and administration by the public authorities of one of the more important means of transportation. The derelict canals offered a unique opportunity of handing over a nominally important and competitive means of transportation to the tender mercies of the inexperienced "quidnuncs" composing the elective administrations through whose territories the canals ran. It was a fairly safe step in the direction of the collective ideal of the State administration of all public services—it was calculated to rather please than to offend the powerful railway interest who would presumably welcome with dissimulated, but none the less real, joy this way of being relieved of a long series of bad bargains which have hung more and more heavily round their financial necks as hard times have made themselves felt.

If the experiment did not succeed, why, perhaps, it would point a useful lesson which might ward off the necessity of satisfying the sleuth hounds of Socialism with a far more costly and important quarry. Frankly, it would be much better to waste £60,000,000 of the taxpayers' money in experimenting with the canals, than to sacrifice 20 times that amount on an equally hazardous venture with the railways. Peradventure the lesser sacrifice might save the necessity for the greater, and the ratepayers might be roused from their habitual apathy by a loss of the magnitude involved, to abandon mere grumbling for once, and give utterance to something like a unanimous cry of halt. Anyhow, beyond the loss of the millions, no serious injury would be done to the commercial interests of the country by tinkering with a derelict means of transportation, which, in any case, could not well be reduced to a condition of less practical utility than it had already reached. Perhaps the scheme for rehabilitating our canals, which we feel confident will be the result of the present inquiry, is, after all, the outcome of the profoundest statesmanship, for £60,000,000 sterling would be a very cheap price to pay for dispelling some of the specious delusions of collectivism—and in this sense we should heartily acclaim its being carried into practice. *Fiat experimentum in corpore vili* as long as the patient on the operating table are our canals and not our railways.

We, however, consider that the experiment would be both more conclusive and valuable if the Government took the canals into their own hands, instead of handing them over piecemeal to the local authorities—in which conditions the failure of the experiment would be too obviously a certainty. The mere diversity in the treatment of the various pieces of canal by the discontinuous policy of a number of elective authorities, of which we have a daily example in our highways, would without anything else reduce the possible utility of the canals far below the level of modern requirements, and could not result in anything else than the repetition or more probably the perpetuation of their present derelict condition, whatever the initial expenditure might be. Now let the experiment, if it must be tried, at least possess the initial advantage which would be assured to it by the extension of the Government permanent staff which has the inestimable advantage of being only in the slightest degree affected by the exigencies of the passing political situation.

If under such an ægis the scheme fails, as we firmly believe it would, in any event, fail, the lesson would be far more valuable for educational purposes than it ever could be when administered by the hands of several dozens of political and elective administrations whose vagaries no one is disposed to take over-seriously, save, perhaps, the unfortunate citizens who are the recipients of their ever-growing precepts to cover the cost of their 'prentice efforts at administration—to call them by no severer name. But the failure of a Government administration to achieve success would be quite another thing, and no one could do otherwise than take it seriously, —for this reason we regretfully admit that it is most improbable that any such experiment will be made. We feel sure that nothing short of the nationalisation of our railways, *absit omen*, could induce any Government to repeat the experiment of the Post Office on any scale of comparable magnitude. And though the administration of this great Government department possesses many unquestionable merits, we fancy that a poll of our great manufacturers and traders would lead to a practically unanimous vote against the confiding of our present essential means of transportation to any department of the character of the General Post Office. The element of competition is the only practical safeguard against the ever-growing disinclination of permanent administrations to any change, whether beneficial or not, which eventually lands them in the conditions characteristic of the mineral kingdom, either amorphous or crystalline.

In an article which appeared in these columns about a year ago we ventured to point out that, apart from the engineering questions involved in the rehabilitation of our canals, the success or failure of this method of transportation depended upon the extension to these waterways of a carrier's organisation at least as efficient as that possessed by the great railway companies in this country. We suggested that it would pay the railway companies to extend their existing organisations to the canals, and in this event the business element of success might be added, and some reality imparted to the proposed rehabilitation. If the Government took over the canals and administered them by a special department, a carrier organisation would, no doubt, be improvised in connection with the provision of the stock of barges and lighters which would be involved, the nucleus of which would be taken over from the existing canal companies with the canals themselves. If, however, the canals were handed over to the local authorities, as we believe they will be if they are expropriated as the result of the present inquiry, then the element of the carrier organisation cannot and will not be provided, and another nail will be firmly driven in the canal coffin. Perhaps, as the venture is intended to be failure, *ex* hypothesis, nothing will be done calculated in any way to interfere with the desired consummation. The appointment of one of our most capable firms of engineers to inquire into and report upon the cost of bringing up certain through lines of canals to several alternative but uniform standards of section and locking facilities, announced recently, shows that it is intended that the inquiry shall bear practical fruit. We venture, however, to predict that in this case also the instructions have been framed in the same way as the terms of the reference for the Commission itself with the object of eliciting confirmation of an already settled plan, that it is intended to enable certain well-defined lines to be followed in dealing with the whole question, and will intentionally provide a practical and much needed anti-socialist lesson which will cost the taxpayer some 60 millions, but which will perhaps be cheaply bought at the price.

THE USE OF BALL BEARINGS ON ELECTRIC MOTORS.

Although there are now many reliable ball bearings on the market, they do not seem to be made use of on electric motors to the extent that one would expect when one considers the many advantages to be gained by their use. The principal advantages are as follows :—

1. *Decreased Length of Machine.*—Ball bearings are usually less than one diameter (of shaft) long, while ordinary bearing brasses are either two and a half, or in most cases, three diameters long, and for this reason the overall length of the machine can be decreased, and consequently a somewhat lighter machine per horse-power can be manufactured, this also means a saving on the packing charges, as the packing cases can also be made shorter to suit. This seems a very small saving, but it is well worth considering when one remembers that many standard series of machines are now manufactured by the hundred.

2. *No Wear on Bearings.*—Owing to the accuracy to which the balls can now be made (Messrs. Hoffmann, for instance, guarantee them to be within one ten-thousandth part of an inch, both as to spherity and to size), to which the races can be machined (Messrs. Ludg. Loewe's D.W.M. ball bearings have the inner and outer races ground to standard sizes within a plus and minus limit of ·0002 in.), and to the hardness of the balls and races, there is no wear

in these bearings, or, perhaps, one should say that after running some years the wear is so small that one is unable to gauge it.

For this reason, these bearings seem to be the ideal bearing for hand-wound closed-slot induction motors, where the air-gap is often cut down as fine as ·025 in.

With the ordinary bearing this has always been a source of trouble, for as soon as the bearing becomes worn the rotor is pulled over by the unbalanced magnetic pull, owing

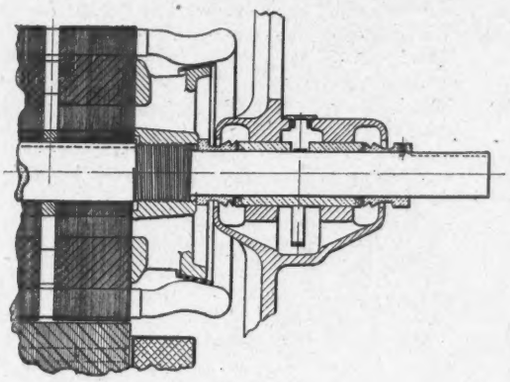


FIG. 1.

to the air-gap becoming smaller at the bottom of the rotor than at the top, or to the difference in air-gap on either side of the rotor in the case of a belt-driven machine.

Some manufacturers have tried to get over this difficulty by boring the bearings slightly eccentric, say, $\frac{1}{100}$ in. above centre, thereby allowing for wear, but this, at the best, is only a poor way out of the difficulty, as it does not allow for wear due to the belt pull, and really as soon as a bearing shows signs of wear it should be rebushed.

3. *No Oil in Bearings.*—Ball bearings should be filled with grease, and they will then run for months without any attention, whereas, with an ordinary bearing using oil lubrication, the bearings have to be inspected at frequent intervals

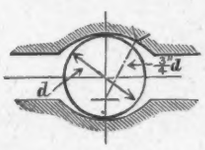


FIG. 2.

FIG. 3.

to see that the oil is up to the proper level for the oil rings to pick up the oil. Moreover, there is always present the trouble of oil creeping along the shaft into the armature, although I must say that troubles of this description are not now so frequent as they were a few years back, owing to the improvement in the design of the oil flingers attached to the shaft; but I know of several cases where a machine, running at fairly high speed, with the pulley end bearing casing close up to the winding support (as shown in fig. 1) has, by the fanning motion set up by the said winding support, sucked or pumped the oil out of the bearing into the machine.

Also, when machines with oil lubrication are used on board ship, there is always the chance of the oil splashing out of the bearing hood owing to the rolling of the ship.

Again, in vertical machines, ball bearings are especially suitable as the lubricating of ordinary vertical bearings is always one of the most difficult points to be contended with in this class of machine. Various means have been tried with more or less success, such as the ordinary siphon wick lubricator, lubricators in which a regulated amount of oil is thrown out by centrifugal force and then led into the bearing, and systems of siphon lubricators to keep the oil at a certain level, but they all have the disadvantage of not being able to use the oil over and over again as one can in a horizontal oil-ring-lubricated machine, and consequently need frequent attention, to say nothing of the liability of oil creeping down into the machine.

By the use of ball bearings it will be seen that this difficulty is entirely overcome. Before going on to the next advantage I would, however, point out that one method of lubricating vertical bearings—namely, by forced lubrication,

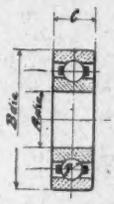


FIG. 4.

has been used with every success on large vertical machines but as this, of course, means independent gear for forcing the oil into the bearing, it need not be taken into account in this article.

4. *Less Starting Resistance.*—Owing to the very small frictional losses the resistance to starting up of a machine fitted with ball bearings is much less than in a machine fitted with ordinary bearings, and consequently the current required to start up is less. The coefficient of friction, unlike that of ordinary bearings, is not higher at starting than when running at the working speed. As the current required to start induction motors is especially much larger than the running current, this is also a point worth considering.

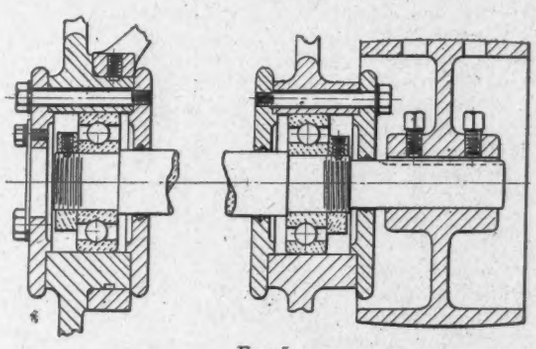


FIG. 5.

5. *Increased Efficiency.*—Again, owing to the friction in ball bearings being very small, a machine fitted with them will give a better efficiency than one fitted with the ordinary bearings, and as an increase of efficiency of only 1 per cent. means a good deal when a machine is in constant use, this is rather an important advantage.

The coefficient of friction for a continuously lubricated bearing is about ·05, while for a ball bearing it is ·0012 to

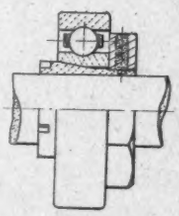


FIG. 6.

·0018, and this is not affected to any extent by the size of the balls or the number of revolutions per minute.

We now have to consider the disadvantages, which are as follows:—

1. *Increased Cost.*—The cost of fitting ball bearings to motors is at present slightly in excess of that for ordinary bearings, but as the call for them becomes greater, I have no doubt but that the prices will fall, as they will then be turned out by the thousand instead of by tens.

2. *Taking up the Thrust.*—The ordinary ball bearing will not take up thrust, so in cases where there is any appreciable

thrust to be taken up, a ball thrust-bearing has also to be fitted in addition to the ball journal-bearing, thereby again increasing the cost, but as there is no appreciable thrust that the pull of the field will not take up in about 90 per

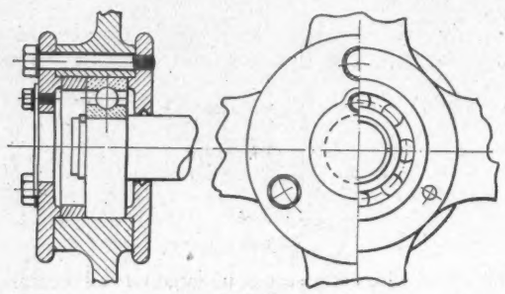


Fig. 7.

cent. of the electric motors manufactured, this point is not quite so important as it would appear at first sight.

These are, I think, the only two disadvantages that ball-bearings possess, and they are easily out-weighed by the many advantages already set out.

The idea that ball-bearings are suitable only for low speeds and light loads is as mistaken as it is prevalent, for D.W.M. ball-bearings have been applied with great success to dynamos, grinding and wood-working machinery, all of which run at high speed. Machines fitted with them have been running satisfactorily for years at 10,000 to 12,000 R.P.M., and the same may be said of line shafting 4 in. to 6 in. diameter, and running at 500 to 1,200 R.P.M. Furthermore, these bearings have been fitted to ventilating fans of up to 15 tons weight, and a periphery speed of 330 ft. per second, so from this it will be seen that this idea, as before stated, is an altogether mistaken one.

There are several varieties of ball-bearings on the market, the two principal types are: (1) Those in which the balls are kept apart by means of springs; (2) those in which the balls are

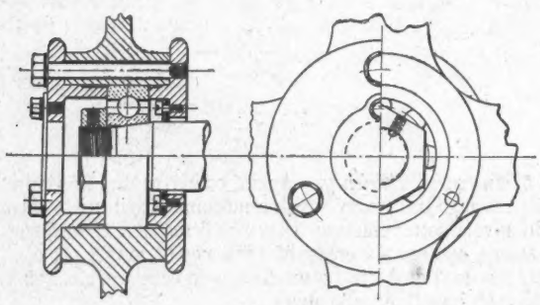


Fig. 8.

kept apart by being placed in a thin ring or cage with holes to suit the size and number of balls, and to my mind the second is far and away the better of the two, as there is nothing to get out of order as in the case of the one fitted with springs.

Too great stress cannot be laid upon the importance of having the balls absolutely correct to standard both in diameter and sphericity (to make them so commercially is, of course, practically impossible, but, as before pointed out, they can be made within one ten-thousandth of an inch), as with hard steel balls running between hard steel races it is of vital importance that the load should be equally distributed. This cannot be the case if a single ball is slightly untrue or larger than the rest, as it is evident that this ball must momentarily be taking the whole load every revolution, and not only damages itself but also the ball race.

Only a fraction of the surface of the balls must touch the races, the actual position of the contact being determined from the axis of the ball. The races should be grooved and the curvature of the groove should represent the arc of a circle somewhat larger than that of the balls. It is also essential that both races should be perfectly continuous, otherwise this will affect the smoothness of the running, and sooner or later cause the deterioration of the bearing.

Too much importance is often attached to the crushing load, which is apt to be misleading, because although a ball will not absolutely crush to pieces until this load is reached, it will, if the pressure is released at about half the ultimate crushing load, be found that the ball is in two pieces. However, with regard to the crushing strength of balls, it may be said, that all things being equal, it increases proportionately as the square of the diameter.

With regard to the safe load on balls: from tests made at the "Central Institute for Technical Investigation" at New Babelsbery, the safe loads for balls running on rounded surfaces (fig. 2) are as in table below, while for plain or conical surfaces (fig. 3) the load must be smaller, and should not exceed about one-fifth of the given figures:—

Dia. in inches ...	$\frac{1}{8}$	$\frac{5}{32}$	$\frac{3}{16}$	$\frac{7}{32}$	$\frac{1}{4}$	$\frac{9}{32}$	$\frac{5}{16}$	$\frac{11}{32}$	$\frac{3}{8}$
Safe load in lb. ...	44	66	100	130	175	220	265	330	395

Dia. in inches ...	$\frac{13}{32}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$
Safe load in lb. ...	460	550	705	880	1,100	1,320	1,585	1,870

Dia. in inches ...	$\frac{7}{8}$	$\frac{15}{16}$	1	$1\frac{1}{16}$	$1\frac{1}{8}$	$1\frac{3}{16}$	$1\frac{1}{4}$
Safe load in lb. ...	2,160	2,470	2,820	3,085	3,415	3,635	3,965

From this table a very simple formula may be obtained, that is, safe load $= .44\ d^2$ when d = diameter of ball in eighths of an inch. It will also be noticed that the loads go up as the square of the diameter.

It should be borne in mind that the permissible load is related to the speed at which the bearings run, and as the

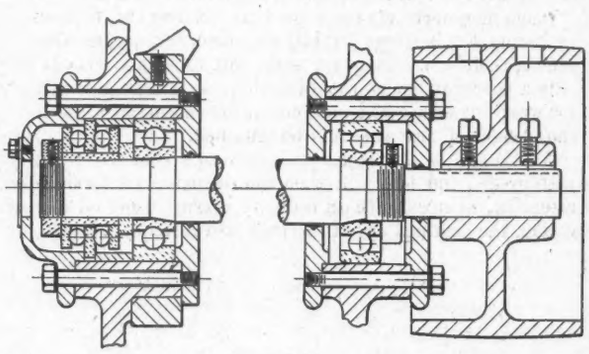


Fig. 9.

number of revolutions per minute is increased so must the load be reduced.

Fig. 4 shows a section through a Hoffmann ball bearing, and the following table gives dimensions and safe loads at various speeds for same:—

A".	B".	C".	D".	No. of balls.	500 R.P.M. lb.	1,000 R.P.M. lb.	1,500 R.P.M. lb.	2,000 R.P.M. lb.	3,000 R.P.M. lb.	4,000 R.P.M. lb.
1	$2\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{8}$	8	900	720	630	575	500	450
$1\frac{1}{8}$	$2\frac{13}{16}$	$\frac{13}{16}$	$\frac{7}{16}$	8	1,100	880	770	700	615	550
$1\frac{1}{4}$	$3\frac{1}{8}$	$\frac{7}{8}$	$\frac{1}{2}$	8	1,400	1,120	980	900	785	700
$1\frac{3}{8}$	$3\frac{3}{8}$	$1\frac{1}{16}$	$\frac{9}{16}$	8	1,700	1,360	1,190	1,090	950	850
$1\frac{1}{2}$	$4\frac{1}{4}$	$1\frac{1}{16}$	$\frac{5}{8}$	8	2,000	1,600	1,400	1,280	1,120	1,000
2	$4\frac{1}{2}$	$1\frac{1}{16}$	$\frac{5}{8}$	9	2,500	2,000	1,750	1,600	1,400	1,250
$2\frac{1}{4}$	5	$1\frac{1}{4}$	$\frac{3}{4}$	8	3,000	2,400	2,100	1,920	1,680	1,500
$2\frac{1}{2}$	$5\frac{1}{2}$	$1\frac{1}{4}$	$\frac{3}{4}$	9	3,500	2,800	2,450	2,240	1,960	1,750
$2\frac{3}{4}$	$6\frac{1}{4}$	$1\frac{3}{8}$	$\frac{7}{8}$	9	4,000	3,200	2,800	2,560	2,240	2,000
3	7	$1\frac{9}{16}$	1	9	5,000	4,000	3,500	3,200	2,800	2,500

From this it will be seen that the load goes down inversely as the cube root of the speed, and up as the square of the diameter of the ball.

We now come to the best way to apply ball bearings to motors.

Fig. 5 shows the arrangement of the bearings for a motor. It will be noticed that no thrust bearing is fitted, as there is no thrust to take up, that is to say, this design allows only for a journal load.

It will also be noticed that the larger or outer race of one bearing is fixed in between two end plates of the housing (in order to fix the position of the shaft some makers, however, advise a small clearance, say, ·05 in. each side, to allow the shaft to find its own position), while that of the other

is loose, in fact, should be a sliding fit in the other bearing housing.

Bearings on machines not fitted with thrust bearings, should always be arranged with clearance on one bearing at

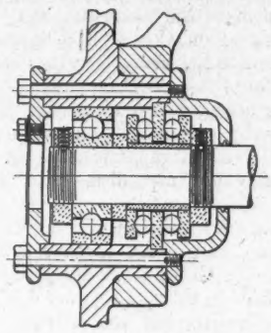


Fig. 10.

least, as it is most important that the spindle should be able to expand or contract lengthwise quite freely to allow for expansion or contraction due to varying temperatures.

At first sight it would seem that this would lead to the outer race revolving with the spindle; this is not so, however, as the friction between the ball race and bearing housing is very great in comparison with the friction between the ball race and the balls.

The inner or smaller race of both the bearings, besides being a tight fit on the spindle, should be clamped against a shoulder or forced on to a cone turned on the spindle (or better still, on to a clamping sleeve where the space necessary for the extra width of these bearings can be spared, fig. 6) by means of a key-ring or nut, which should always be locked to prevent any tendency to slacking back (figs. 7 and 8).

Covers should also be fitted over the housing ends to prevent both the grease from getting out and the dust from getting in, and for this reason the covers should be run with as small a clearance round the shaft as possible; as there is no wear on the bearings, there is no chance of the shaft seizing at this point, so the clearance can be made very small indeed, say, $\frac{1}{64}$ in. total; with this clearance and a V groove in cover (fig. 7) no grease will escape. Where it is not thought wise to run the clearance so fine, a leather or felt washer should be fitted running down right on to the shaft (fig. 8).

Fig. 9 shows the arrangement of bearings for a motor fitted with both thrust and journal ball bearings.

The whole of the journal load must be taken by the

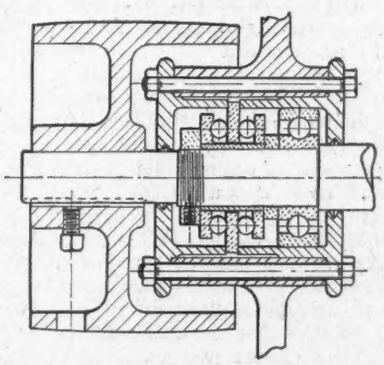


Fig. 11.

journal bearings, as the thrust bearings will not take any share of this load.

It will be noticed that a double thurst bearing is shown, as it has been found the best practice to fit a double thrust in preference to a single thrust bearing, as by this means the thrust is taken up in both directions, besides fixing the position of the shaft lengthwise, therefore both journal bearings can be a sliding fit in their respective housings. It is not, however, always found convenient to do this, so in some cases the outer race of the journal next the thrust bearing is held as shown in fig. 9, for being close to the thrust bearing, the contraction or expansion taking place between these two points is so small that it can be neglected. The other bearing must, however, be a sliding fit in its housing, for the reasons already pointed out.

Figs. 10, 11 and 12 show bearing housings in which the journal bearing next the thrust bearing is a sliding fit in its housing.

In fig. 10 the thrust bearing is in between the two journal bearings, this, however, is not very good practice, as

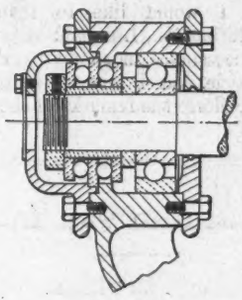


Fig. 12.

it means increasing the distance between the centres of the journal bearings.

Fig. 11 shows the thrust bearing at the pulley or coupling end of the machine, this also is not a very good design, as it means increased overhang from the centre of the journal bearing to the centre of the pulley, but of course this could be minimised by letting the pulley overhang the housing as shown; it would, however, be very suitable for a coupling drive.

Fig. 12 again shows the thrust bearing at the end of the machine remote from pulley or coupling; if this design is used, however, the housing should be split, otherwise the thrust bearing must be taken off the shaft before the end cover or bracket can be taken off the machine.

Fig. 13 shows the arrangement of bearings for a motor arranged vertically.

With a vertical machine it is, of course, always necessary to fit a thrust bearing, but as the thrust is always downwards, a single thrust bearing only is necessary, and the

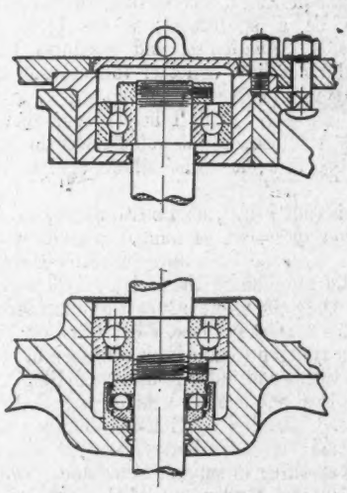


Fig. 13.

journal bearings may be of a much lighter design than is the case with a horizontally-arranged machine, as they have practically no load except that due to out-of-balance magnetic pull and have only to keep the shaft in position.

It will be seen that the thrust bearing is arranged in the bottom bracket, as by this means the top cover or bracket may be made much lighter than would be the case if the thrust were taken up at the top bearing instead of the bottom, as the weight of the rotor would then have to be carried by the top cover.

Of course, if necessary, this could be done when it is thought advisable to have the thrust bearing more accessible.

Again, the journal bearing remote from the thrust bearing

must be a sliding fit in its housing to allow for expansion or contraction in the length of the shaft.

The writer would point out that the only likelihood of a well-designed ball bearing failing is when overloaded or badly fitted, and therefore, when the load to be carried is somewhat high, or in any special cases, it is always best to consult the manufacturers as to the size of bearing they recommend under the circumstances.

In conclusion, I would like to thank Messrs. The Hoffmann Ball Bearing Co., Ltd., and Messrs. Ludw. Loewe and Co. for their assistance in supplying various data contained in this article, and I might add that both of these firms thoroughly endorse the remarks in the last paragraph.

SOCIALISM AND THE INDUSTRY.

By BEN FRANK.

The telephone bell rang. "The managing director wants to see you at once," said the office boy, as he hung up the receiver. "Oh, tell him I'm busy," I exclaimed, with a show of impatience. I was in the midst of an important estimate, and had got the details well in mind; interruption meant loss of time in going back to pick up the lost threads. However, the boy knew better than to send such a reply to the M.D.; he probably never heard it. Having delivered his message, he continued his comic sketches on the blotting pad.

"Oh, good morning, Mr. Frank!" said the M.D. with formal politeness. "I just want a word with you"—and he motioned me to a seat. This was unusual; however, I sat and tried to appear comfortable.

"You are somewhat of a Socialist, I hear!" If I had not been already seated, I believe I should have collapsed from sheer amazement.

Now who or what on earth could have given the M.D. the impression that I was a Socialist? True, I had attended a few socialistic meetings, but if that makes one a Socialist, I ought to be a spiritualist, a freethinker, an anti-vivisectionist, a Salvationist, and goodness knows what besides. I did not know whether to feel insulted or merely ashamed. It was obvious that the M.D. spoke more in sorrow than in anger. Still, I held a somewhat important position with the firm, and it would never do for me to be ranked as a Socialist; it might militate against my advancement.

The fact is that I had, as hinted above, attended a few I.L.P. election meetings. I wanted to know what were the fundamental ideas of such men as Keir-Hardie and his followers, who represented the socialistic element in Trades Unionism. Only the night before this extraordinary interview with the M.D. took place, I had stood on the back seat in the Town Hall, surrounded by workmen of the advanced school, men whose politics were indicated by the wearing of flaming red ties and slouch hats of the Trilby or stage-villain type. Hardie, or Keir-Hardie to give him the hyphen which is the hall mark of an aristocratic lineage, was speaking in support of a Labour candidate who was opposing John Morley, one of the two-and-only honest Johns.

As Hardie faced the crowded audience, punctuating his remarks with blows from his clenched bony fist, his shock of hair and beard quivering with excitement, and his small eyes flashing fire, he exhorted his hearers somewhat after this fashion: "Comrades and fellow workmen, you are the men who produce the wealth of this country—working from early morn till dewy eve, in the sweat of your brow, you are toiling to keep your employers in luxury, whilst you receive in wages sufficient only to keep you out of the workhouse. You are being robbed of your earnings, but the robbers instead of being in jail, are living in the lap of luxury at your expense.

"Who win the coals that burn in the grates of the capitalists? You, whose children shiver with cold! Who make their boots, their clothes and their finery? You, my comrades, whose children often go barefoot and in rags! Who build their houses? You, masons and bricklayers, who live huddled in overcrowded tenements, under much worse conditions than the rabbits kept by your employers' pampered children! Who make the motor-cars and carriages which will carry the Liberal and Conservative electors to the poll? You, men of the A.S.E., many of whom cannot afford the price of a tram fare!

"Has it never occurred to you, that the man who has the most right to a thing, is he whose labour has produced it? Why should the so-called capitalists always take the lion's share? You also are capitalists—your labour is your capital.

"On the polling day the Liberals and Conservatives will send round their carriages and motor-cars to take you to the poll. Ride in them, they are partly yours, for you made them. Ride in them, I say, *but* don't vote Liberal; don't vote Conservative, but vote straight for one of your own class; help us to get a majority of working men in the House of Commons, and then, and not till then, will the working classes be able to successfully demand that which rightly belongs to them."

These were probably not Hardie's words, but it is the gist of what I remember of the speech, which was punctuated with applause and such cries as "Good old Hardie," "Give it 'em hot, lad," "canny lad," &c.

Nor need we go for such views to men of the Hardie stamp, whose early training and environment are, perhaps, a sufficient explanation of their attitude toward those who started life a few rungs higher than they on the social ladder. Such views are now advanced in other form by men of education, culture and refinement, men who expect the middle classes at any rate to treat them as sane and serious politicians. Men, for example, of the stamp of Mr. Chiozza-Money, M.P.

Mr. Money can write very sensibly. Sometimes he does so. But a short time ago Mr. Money took it into his head to write about the Newcastle-on-Tyne Electric Supply Co. He had seen the balance-sheet for the year 1905, and his righteous indignation got the better of him. He wrote to point out that in the financial year referred to the amount paid to capitalists for loan of tools, &c., was £74,000, whereas the amount paid to the workers, including salaried officials, was a mere £34,000. This forms, says Mr. Money, "a concrete illustration of the simultaneous manufacture of riches and poverty;" and, whilst the labourer is put off with a modest pittance, the wicked "capitalist, who stands and waits, receives the lion's share." One is tempted to write a sermon on the text, "stands and waits," for the grasping capitalists referred to, many of whom, by the way, are people in comparatively humble circumstances, who have invested their savings in the Newcastle Electric Supply Co., did a good bit of "standing and waiting" in the early years of the company's history. It is such arguments as these, put forward by such well-intentioned Socialists as Mr. Money, which give the impression that Socialism means confiscation, a more polite word than robbery. If there were anything at all in the argument, why should it be necessary to take the most prosperous year of a company's operations and leave out the lean years? Why not, for instance, take the year 1902, when it would be seen that the amount paid to the workers was £10,600, and the amount to the greedy capitalists, who stand and wait, a little over £11,400. It is only necessary to take earlier years in order to show the balance on the other side, and there are many industries in which the costs of labour play a very predominent part in the total expenditure.

This point of view, however, is an utterly foolish and stupid one, and proves absolutely nothing. Thus, instead of taking the total operations of the concern, we might subdivide it and show that on the conductors sunk in the ground, capitalists are continually standing and waiting and drawing the lion's share, the workers getting practically nothing. This would, of course, overlook the fact that the workers had already been paid for mining the raw material, for making the stamping, crushing and other mining plant, for making and manning the ships and railways which brought it over, for making the various machinery employed in converting the raw material into the finished product of electric cables and of finally laying the cables underground.

The same considerations apply not only to the cables but to the whole of the generating plant and buildings. It is, in fact, almost impossible to compute the proportionate share which has been paid to labour in connection with the plant and materials used in the generation of electricity.

But, as mentioned above, when we have shown all this, we have proved nothing, for it is still quite possible for very large percentage dividends to be paid on a small capital, whilst the actual amount paid bears a comparatively small value to that paid in wages, even though the wages paid were starvation wages. Yet on Mr. Money's argument we could say that "here we have a concrete illustration of the simultaneous manufacture of riches and poverty," the riches in this instance going to the sweated workers and the mere pittance to the bloated capitalists.

These so-called arguments are not put forward for nothing. The object is to make it appear that in the electrical industry, as in other manufacturing industries, capital gets such an unfair proportion of the profits as practically amounts to legalised robbery of the working classes. It may in some cases be so, but the arguments referred to do not show it.

The socialistic remedy for this state of things is the nationalisation of all the means of production and distribution, and the abolition of private property.

As a preliminary, or as my countrymen would say, "a biting on," we are to have the nationalisation of land, for which there is a great deal to be said. (I don't own any land.)

The State is also to give free education to the workmen's children, the State is to provide the children with free food, the State is to provide work for the out-of-works, and the State is to provide pensions for them when they are too old to work. But (there is always a but) the workman is to contribute nothing whatever to the State fund from which the pension is paid. So that when we are all Socialists, we shall all get from the State something for nothing, and we shall amend and modernise the old proverb, *Ex nihilo nihil fit*. It is rather a pleasing prospect!

The substance of the Socialist's *pater noster* is "that we might all be rich," and his Heaven is a state in which everybody will be rich, and equally rich. There is a growing movement which claims that the principles of Socialism and Christianity are identical, a movement which ignores the essential difference between the desire to become rich by confiscating that which belongs to another, and the will to become poorer by giving of one's substance to those who have none.

The spirit of giving, not taking, is the true Christian spirit, and when this spirit shall have become universal we shall have reached the essential conditions of true Socialism. It is a long way off.

During one of the great engineering strikes a powerful and wealthy Trade Union appealed to other Trade Unions for financial support. They almost demanded it as a right. Were they not fighting the battle of Unionism? But, did this wealthy Trade Union, or any of the wealthy Trade Unions put out its little finger to help the poverty-stricken nail-makers in their strike for better conditions? Did they give as well as take?

But we are digressing. I am carpeted in the private office wondering what is at the back of the M.D.'s head, when he says "I believe you are something of a Socialist, Mr. Frank." To say that I was a little embarrassed is to put the state of the case very mildly. However, I managed to reply: "Well, sir, if Lord Salisbury is correct in saying that we are all Socialists now, I suppose I am." I was not at all sure who was the originator of the phrase, but I felt I must say something in order to temporise.

But the M.D. seemed inclined to be pleasant. "The Socialists want to make everybody equal, don't they?" he asked, "to pool everything, and then divide it all out in equal parts, the whites and the blacks, the yellow skins and the red skins all to share equally.

"They have some kind of theory of that sort, I believe, but they do not go quite so far as that yet. I don't think the blacks and the other coloured gentlemen come in. From what I can gather they think that there is too much contrast between the rich and the poor, and that the millionaire could not have earned his millions honestly, or without monopolising something which should be common property. Henry George, I believe, puts it that no living man can, by his own unaided exertions, earn more than, say, ten times the earnings of the average man—I think he said ten, but it might have been less—and that it should, therefore, be made impossible for him to earn more than a certain maximum."

"Then he would say, I suppose," said the M.D., smiling, "that a man like Sir John Blank, the managing director of the railway company, is not worth more than ten average railway porters. You can't estimate the work of a manager, like that of an artizan. Here is a man controlling millions of other people's money, to say nothing of his responsibility for millions of human lives. It depends upon his management whether the thousands of shareholders get a dividend or none. Why, the salary he gets is a mere bagatelle to the loss which the shareholders would sustain if—"

"I don't think the Socialists care very much about the shareholders," I interrupted, "they are classed as capitalists."

"Very well," pursued the M.D., "look at it from the employés point of view, then. If there is no dividend for the shareholders, in other words, if there are no profits, a reduction either of wages or numbers would follow, and whichever it was, the salary of the managing director would still be quite negligible in comparison to the loss to the workmen. But, we could discuss this all day, and it is not what I called you down for. However, there is one thing you will find, and that is that the more money you get the less socialistic you will become."

I began to wonder now why the M.D. had sent for me, and what made him talk about Socialism to me. Obviously he had a very simple remedy for any socialistic tendency on my part. All he had to do according to his own theory was to raise my salary. Such theories are usually left to others to test on a practical scale. No doubt he had the other honest John in mind. I remember hearing Burns about 20 years ago under the Reformer's tree in Hyde Park—but I must not digress again.

After a preliminary cough, the M.D. came to the point. "We have just been balancing up the accounts for the year"—now it's coming, I thought; retrenchment and reform to be put into operation—"and find we have had a very good year"—Oh! "We feel that you have helped largely to make the year so successful, and wish to express our appreciation of your services." Picking up an envelope from his desk, he continued, "Here is a cheque for you equal to a quarter's salary, and we hope we shall have the pleasure of repeating the dose at the end of the next financial year."

I don't know if I am yet less of a Socialist than before, but it has occurred to me this Christmas that there is far more of the true socialistic spirit in my managing director, who voluntarily shares his profits with his staff who have done their little best, than in some of the stump orators who claim that all the profits of production belong to the workmen, and that the capitalist is a mere parasite feeding on the vitals of labour.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

26,125A. "Improvements in electric switches." A. F. WILEMAN. (Date applied for under Rule 5 of the Patents Rules, 1905, November 26th, 1907). December 24th.

28,222. "Electric trolley pole improvement and wheel guide for electric tramcars and the like." W. WYE. December 23rd.

28,227. "Improvements in the manufacture of electric incan descent lamps." THE EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD., and E. A. GIMINGHAM. December 23rd.

28,228. "Improvements in the manufacture of electric incandescence lamps." THE EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD., and E. A. GIMINGHAM. December 23rd.

28,255. "Improvements in apparatus for electrically-igniting miners' safety lamps or the like." E. A. HAILWOOD. December 23rd.

28,281. "Collapsible trolley pole for electric vehicles." G. S. THOMSON. December 23rd. (Complete.)

28,289. "Improvements in and relating to circuit breakers." E. N. BRAY and BRAY, MARKHAM & REISS, LTD. December 23rd.

28,291. "Improvements in connection with incandescence electric lamps." C. H. STEARN and C. F. TOPHAM. December 23rd.

28,305. "Improvements in dynamo-electric machines." E. SCHIKTANZ. December 23rd.

28,367. "Improvements in electric motor-starters." E. SCHATTNER. December 24th.

28,388. "Improvements in or connected with the regulation of electric lamps." THE THAMES IRON WORKS, SHIPBUILDING AND ENGINEERING CO., LTD., and W. H. FLOOD. December 24th.

28,410 "Improvements in and relating to dynamo-electric machines for generating 'continuous' current without the use of revolving commutators." C. F. MACKNESS. December 24th.

28,412. "Improvements in signalling by electro-magnetic waves." R. A. FESSENDEN. (Date applied for under Patents Act, 1901, January 14th, 1907, being date of application in United States.) December 24th. (Complete.)

28,425. "Improvements in electric measuring instruments." ALLGEMEINE ELEKTRICITATS GES. (Date applied for under Patents Act, 1901, January 2nd, 1907, being date of application in Germany.) December 24th. (Complete.)

28,426. "Improvements in insulators for overhead systems of electric railways and the like." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) December 24th.

28,436. "Improved electric signalling system for railways." A. GARDINER. December 27th.

28,496. "Improvements in electric signalling for railways." A. GARDINER. December 27th.

28,447. "Improvements in means for preventing accidents on electric railways." J. V. DICKINS. December 27th.

28,451. "Method of and apparatus for lengthening the burning life of electric incandescent lamps." W. HERRMANN. December 27th. (Complete.)

28,457. "Improvements relating to magnetic clutches, couplings and the like." A. SMITH and C. SOUTHALL. December 27th.

28,472. "Emergency brake for electric or other tramcars and all kinds o carriages or trucks that are run on metals." G. BINGHAM. December 27th.

28,476. "Improved lampholder and shade carrier for screw cap electric lamps." C. M. ESCARE, P. F. ESCARE and C. DAMEY. December 27th.

28,481. "Improvements in or relating to what are commonly known as homopolar electrical generators and motors." R. H. BARBOUR. December 27th.

28,482. "Improvements in or relating to electrical brushes or collectors." R. H. BARBOUR. December 27th.

28,483. "Improved means of rapid excitation for the dynamos of petrol electric automobiles and for other purposes." W. A. STEVENS. December 27th.

28,494. "Jointing system for preventing the falling of the aerial wires of electric tramways." A. G. BOON and F. MELLAERTS. December 27th. (Complete.)

28,507. "Improvements in or relating to electrical overload indicators." H. T. HARRISON. December 27th.

28,550. "Improvements in and relating to dynamo-electric machines." MATHER & PLATT, LTD. (E. Rosenberg, Germany.) December 28th. (Complete.)

28,542. "Improved electrical induction furnace." A. HJORTH. December 28th. (Date applied for under Patents Act, 1901, Jan. 4th, 1907, being date of application in Norway.) (Complete.)

28,592. "Improvements in apparatus for testing telephone wires." J. M. MILLER and C. J. MURRAY. December 30th.

28,619. "Improvements in secondary batteries." E. C. EKSTROMER and H. EKSTROMER. December 30th. (Complete.)

28,634. "Improvements in electric locomotives." B. G. LAMME and N. W. STORER. December 30th. (Date applied for under Patents Act, 1901, January 5th, 1907, being date of application in U.S.) (Complete.)

28,652. "Improvements in and relating to electrical transformers and the like. H. M. HOBART and F. B. CRAMER. December 30th.

28,664. "Improvements in and relating to electro-galvanising apparatus of the revolving cylinder type." F. H. HORNBLOWER. December 31st.

28,677. "Improvement in the method of and means for operating and controlling the electric circuits of lamps of electrically illuminated signs and the like." H. C. HARPER. December 31st.

28,690. "Improvements in cable telegraphy." I. KITSEE. December 31st. (Complete.)

21,694. "Improved method of advertising by an electrically or mechanically-controlled machine." G. WALLACE. December 31st.

29,695. "Improved galvanic primary battery for motor ignition purposes and the like." G. WALLACE. December 31st.

28,696. "Improved method of preventing the opening of railway carriage doors whilst train is in motion." G. WALLACE. December 31st.

28,736. "Telegraph typewriter." G. A. CARDWELL. December 31st.

28,738. "Improvements in and connected with electrical ignition devices." C. EBNER. December 31st.

28,748. "Improvements in and relating to methods of electric train-lighting and apparatus therefor." J. DALZIEL. December 31st.

PUBLISHED SPECIFICATIONS.

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1906.

SIGNALLING SYSTEMS FOR RAILWAYS AND THE LIKE AND APPARATUS THEREFOR. British Thomson-Houston Co. (C. J. Kintner.) 19,787. September 5th.

ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. (General Electric Co., United States.) 21,873. October 3rd.

ELECTRIC INCANDESCENT LAMPS. F. W. Le Tall. (A. Lederer.) 24,179. October 30th.

CONTROL OF ELECTRIC MOTORS. British Thomson-Houston Co. (General Electric Co., United States.) 24,418A. November 1st. (Date applied for under Rule 5, Patents Rules 1905, November 1st, 1906.)

ANODES FOR ELECTRO-DEPOSITION. S. O. Cowper-Coles. 26,212A. November 19th. (Post-dated June 19th, 1907.)

ANODES FOR ELECTRO-DEPOSITION. S. O. Cowper-Coles. 26,212B. November 19th. (Post-dated June 19th, 1907.)

ANODES FOR ELECTRO-DEPOSITION. S. O. Cowper-Coles. 26,212C. November 19th. (Post-dated June 19th, 1907.)

ELECTRO-MAGNETICALLY OPERATED DEVICE FOR CIRCUIT CLOSING, INDICATING, TRANSMITTING POWER, AND OTHER PURPOSES. G. L. Anders and A. T. M. Thomson. 27,204. November 29th.

SYSTEMS OF ELECTRIC TRAIN LIGHTING. H. Leitner. 27,211. November 29th.

APPARATUS FOR ELECTRICALLY FIRING MINES OR THE LIKE. K. Schaffler and L. Weiss. 27,318A. November 30th. (Date applied for under Rule 5, Patents Rules 1905, November 30th, 1906.)

APPARATUS FOR ELECTRICALLY FIRING MINES OR THE LIKE. K. Schaffler and L. Weiss. 27,318B. November 30th. (Date applied for under Rule 5, Patents Rules 1905, November 30th, 1906.)

ELECTRICAL COMMUNICATION BETWEEN GUARD AND DRIVER, WARNING THEM OF THE OPENING OF DOORS WHILST IN TRANSIT. H. Crepin. 27,593. December 4th.

DOUBLE-CARBON ELECTRIC ARC LAMP HAVING INCLINED CARBON HOLDERS. J. Brockie. 27,725. December 5th.

ELECTROLYTIC REFINING OF COPPER. S. O. Cowper-Coles. 27,740. December 5th.

ELECTRIC JUNCTION BOXES FOR TELEPHONE SYSTEMS. L. Schörg and K. Löhner. 28,127. December 10th. (Date applied for under International Convention, December 11th, 1905.)

APPARATUS FOR COOLING DYNAMO-ELECTRIC MACHINES. B. Bidwell. 28,189. December 11th.

SWITCH CONTROLLING MECHANISM FOR ELECTRICAL INSTALLATIONS. British Thomson-Houston Co. and J. E. Woodbridge. 28,112. December 10th.

1907.

PNEUMATIC DISTRIBUTING SYSTEMS FOR ELECTRICALLY-PROPELLED VEHICLES. Allgemeine Elektricitäts Ges. 20,800. September 11th. (Date applied for under International Convention, September 12th, 1906.)

WIRELESS TELEGRAPHY AND TELEPHONY. L. Maiche. 21,252. September 25th.

TELEGRAPH SYSTEMS. T. W. Mackenzie and W. C. Mackenzie. 1,061. January 15th.

TELEPHONE SYSTEMS. E. A. Graham. 3,935. February 16th.

DEVICE FOR WORKING ELECTRIC ALARMS IN USE WITH DOORS, DRAWERS AND THE LIKE. H. E. Ives. 3,963. February 18th.

SWITCHES FOR ELECTRIC LIGHTING, HEATING AND THE LIKE. A. P. Lundberg, H. Lundberg and W. Lundberg. 5,826. March 11th.

APPARATUS AND MEANS FOR SECURING INCANDESCENT ELECTRIC LAMP-HOLDERS AND OTHER APPARATUS TO THE LEADS OR MAINS. A. E. Beattie and S. E. Barnes. 6,912. March 22nd.

ARRANGEMENT OF THE FILAMENT OF A HIGH VOLTAGE ELECTRIC LAMP OF SMALL ENERGY CONSUMPTION. C. Glogau. 8,761. April 15th.

METHOD OF AND APPARATUS FOR DETERMINING THE POSITION OF AN OBJECT OR THE LIKE WHICH HAS BEEN DETECTED WITH AID OF RONTGEN RAYS. J. Gillet. 10,328. May 3rd. (Date applied for under International Convention, May 4th, 1906.)

ELECTRIC CURRENT DISTRIBUTING SYSTEMS. Siemens-Schuckert-Werke Ges 15,418. July 4th. (Date applied for under International Convention, July 5th, 1906.)

ASH TRAY FOR ELECTRIC ARC LAMP GLOBES. W. S. Davy. 18,513. August 15th.

PROTECTIVE DEVICES FOR ELECTRIC TRANSMISSION SYSTEMS. British Thomson-Houston Co. (Allgemeine Elektricitäts Ges.) 156. January 3rd.

DYNAMO-ELECTRIC MACHINES. J. C. Lincoln. 880. January 12th. (Date applied for under International Convention, January 12th, 1906.)

PROTECTIVE DEVICES OF THE TYPE KNOWN AS LIGHTNING ARRESTERS. British Thomson-Houston Co. (General Electric Co., United States.) 1,854. January 24th.

MEANS FOR TRANSMITTING POWER TO DYNAMO-ELECTRIC MACHINES CARRIED BY VEHICLES. S. E. Page. (United States Light and Heating Co.) 2,759. February 4th.

COOLING AND VENTILATION OF ROTARY OR OTHER ELECTRICAL APPARATUS. G. Westinghouse. 6,118. March 13th.

PRIMARY BATTERIES. H. W. Lake. (C. E. Hite.) 9,477. April 23rd.

ELECTROLYTIC SHIP-BOTTOM PROTECTOR. J. H. Schoneberger and G. W. Frazier. 13,674. June 13th.

MEANS FOR PREVENTING INDUCTIVE DISTURBANCES AND FOR PHASE ADJUSTING IN TELEPHONE, TELEGRAPH AND OTHER ELECTRIC CIRCUITS. C. A. Scott. 14,753. June 22nd. (Date applied for under International Convention, July 9th, 1906.)

MANUFACTURE OF ELECTRIC INCANDESCENT LAMP FILAMENTS CONSISTING OF DIFFICULTLY FUSIBLE METALS. A. G. Bloxam. (Siemens & Halske Akt.-Ges.) 17,973. August 7th.

ELECTRIC INCANDESCENT LAMPS. Westinghouse Metal Filament Lamp Co. 18,923. August 22nd. (Date applied for under International Convention, November 23rd, 1906.)

Iron and Steel from Black Sands.—"Black sands" is a term used to embrace the residual sands left in concentrating placer gravels. These have a specific gravity above 3, and consist principally of minerals of the nature of magnetite, gold, ilmenite, haematite, platinum, mercury, iron silicates, &c. These can be separated by concentrating machines, and made available for electric steel. In a series of experiments it was attempted to produce steel in the electric furnace in one operation, but the product varied greatly and was not sufficiently under control to form a successful commercial operation. This is due to the three chief requirements:—(1) Reduction of the metal from the ore. (2) Oxidation of surplus carbon and impurities. (3) Deoxidation and killing. The conditions necessary for one operation are directly opposed to those of another. At the sacrifice of a certain amount of iron, however, much of the carbon can be kept out of the metal. The refining may then be accomplished quickly, and this may prove the best practice where steel is the final product desired. In a second series of experiments the process was divided into two steps; first, iron smelting, and, second, steel making. In the first furnace the metal could be reduced and part of the impurities removed, and tapped into the second without a carbon lining. In this furnace the oxidation could be finished, and deoxidation and killing could be carried on to any degree desired. The dimensions of the first furnace were: Bottom plate, 60 by 72 by 3 in.; shell, 60 in. by 60 in.; carbon crucible, 20 by 20 by 31 in. with sides 3 in. and bottom 28 in.; movable electrode, 10·5 by 10·5 by 38 in. The second furnace was of the Héroult type designed to use 4-in. electrodes. The lining was crushed chromite and fireclay. Carbon proved unsatisfactory as a lining in the first, and was replaced by silica brick, but this rendered a high column of charge in the furnace impracticable, and it was found necessary to maintain an arc between the surface of the bath and the electrode. The iron produced was close-grained grey iron of remarkable toughness, amounting to 152 lb. for an expenditure of electrical energy estimated at 560 KW.-hours. The results, on the whole, are by no means conclusive, and have not yielded definite data. (United States Geological Survey, *Electrochemical and Metallurgical Industry*, Vol. V, 3.)